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3.
PUBLIC WORKS MINISTRY.

REPORT

UPON THE

ADMINISTRATION OF THE PUBLIC WORKS DEPARTMENT IN EGYPT

FOR 1902

BY

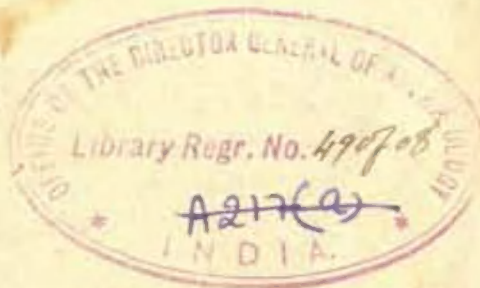
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SIR WILLIAM GARSTIN, G.C.M.G.,

UNDER SECRETARY OF STATE, PUBLIC WORKS DEPARTMENT

WITH REPORTS BY THE OFFICERS IN CHARGE OF THE SEVERAL BRANCHES
OF THE ADMINISTRATION

352.505
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PUBLIC WORKS DEPARTMENT.

ADMINISTRATIVE REPORT FOR THE YEAR 1902.

To my present Report, I have, as usual, attached those submitted to me by the heads of the different Services which depend upon the Ministry of Public Works. They consist of the following :—

I.—*The Irrigation Service.*

- (a) Report by Mr. K. Verschoye, C.M.G., Inspector General of Irrigation, Upper Egypt.
- (b) Report by Major Sir R. H. Brown, K.C.M.G., Inspector General of Irrigation, Lower Egypt.
- (c) Report by Mr. A. L. Webb, C.M.G., Director General of the Nile Reservoir Works.

II.—*Services, other than Irrigation.*

- (d) Report by Mr. A. H. Perry, Director General of Towns and Buildings.
- (e) Report by Captain H. G. Lyons, Director General of the Survey Department.
- (f) Report by Mohamed Bey Anis, Chief of the Technical Service.
- (g) Report by Monsieur G. Maspéro, Director General of the Antiquities Department.
- (h) Report by Mr. G. Gunn, Inspector for the Agricultural Railways to the Ministry of Public Works.
- (k) Report by Captain Stanley Flower, Director of the Government Zoological Gardens.

EXPENDITURE.

The following tables show the total sums expended in 1902, under the Budget of the Ministry of Public Works:—

TABLE I.

ORDINARY BUDGET.

	£ E.	MILL.
Central Office Charges...	41570	695
Irrigation Service...	619711	080
Towns and Buildings	210914	334
Survey Department	34005	912
Technical Service...	15134	261
Antiquities Service	13184	514
Total...	<u>£E.934520</u>	<u>796</u>

This total is less, by £E.17932,131 mill., than that of the year 1901, the reduction being chiefly due to cessation of expenditure upon Agricultural Roads, and to the transfer of the Scavenging and Watering Service to the Sanitary Department:—

TABLE II.

EXTRAORDINARY BUDGET, OR NEW WORKS EXECUTED UPON SPECIAL CREDITS.

	£ E.	MILL.
New Weirs, (money granted by the Caisse) ...	2235	195
Zifta Barrage (money granted by the Caisse) ...	209081	122
Drainage Works (money granted by the Caisse) ...	68557	755
Irrigation Improvements (money granted by the Caisse)	495937	233
Public Buildings (money granted by the Caisse) ...	216641	149
Public Buildings (money found by other Departments).	22533	370
Total...	<u>£E.1014985</u>	<u>824</u>

This exceeds by £E.110203,103 mill. the expenditure, under the same head, in 1901,

In addition to the expenditure shown in Table II, certain further sums were devoted to works, not included in the above list, the credits for which were derived from various sources. This expenditure I have, as in last year's Report, grouped into a special Table, entitled "Various Extra Credits":—

TABLE III.

VARIOUS EXTRA CREDITS.

I.—*Money granted by the Caisse.*

	£E.	Mill.
Various Irrigation Works	45143	463
Museum Catalogue	1960	116
Repairing Karnak Temples	1758	473
Repairing Philæ Temples	12757	563
	<u>61619</u>	<u>615</u>

II.—*Money supplied from other sources.*

	£E.	Mill.
Revenue Survey	20173	000
Irrigation Works	2447	035
Cairo City	2846	114
Provincial Towns	215	968
Public Buildings	6007	588
	<u>31689</u>	<u>705</u>
Total... ..	<u>£E.93309</u>	<u>320</u>

The expenditure in this table is greater than that for the year 1901, by £E.31450,841 mill. The excess is chiefly due to the expenditure upon the low flood, and the repairs to the Philæ Temples.

The following table gives a summary of the year's expenditure:—

TABLE IV.

TOTAL EXPENDITURE IN 1902.

	£E.	Mill.
Ordinary Budget	934520	796
Extraordinary Budget	1014985	824
Various Extra Credits	93309	320
Total... ..	<u>£E.2042815</u>	<u>940</u>

The above total exceeds that of 1901, by £E.123721,818 mill.

The payments made in 1902, to Sir John Aird and Co. for works connected with the Nile Reservoirs amounted to Pounds Sterling, 350992, or, £E.342217,200 mill.

Adding this last sum to the figure given in Table IV, the total expenditure controlled by the Department of Public Works, in 1902, was £E.2385033,140 mill.

This is less than the total expenditure for 1901, by £E.372021,807 mill.

This diminution is due to the fact that, last year, the Reservoir works were practically completed and the expenditure did not reach that of the previous year.

I will now describe the progress made by the General Services in 1902, separating my Report into two portions, viz, "Irrigation Works," and "Works other than Irrigation."

Part. I.—THE IRRIGATION SERVICE IN 1892.

THE NILE SUPPLY

At the end of the year 1901, it seemed more than probable that the summer supply of 1902 would be a very poor one. This anticipation was fully realised and, for the third year in succession, an exceptionally low discharge was recorded during the summer months.

On the 1st of January 1902, the Aswan gauge registered a water-level, 0.81 metres below the average of the thirty preceding years. With the exception of 1899 and 1900, this was the lowest level recorded for the date in question.

Throughout the early summer months, very low levels were maintained. On the 5th of June, the first slight rise commenced, but for the next three and a half months, the increase was extremely slow and the flood promised to be an exceptionally poor one. On the 15th of August, the Aswan gauge registered a water-level, 1.30 metres lower than any level previously recorded for this date. It was also 2.50 metres below the average level (for the same date) of the thirty years previous to 1892.

The river gauges in the Soudan, at the same time, recorded ominously low water-levels, and showed no indications of any improvement. The White Nile was very low, and the Atbara had failed entirely. The Blue Nile alone saved the situation by maintaining a fairly good supply. Throughout the early days of September, the levels continued to be unprecedently bad, and anxiety concerning the Basin Irrigation, south of Cairo, was very general.

Happily, at the last moment, the situation changed for the better, as a timely further rise of the Blue Nile and a late, though fair, flood in the Atbara brought up the levels of the river in Egypt.

The maximum gauge of 14 pies, at Aswan, was reached on the 17th of September. From this date, the levels were well maintained and the fall was a gradual one.

During the month of October, the river fell slowly, and by the end of November, the water-levels were coincident with those, for the same

period, in 1900 and 1901. The late attainment of the maximum level, together with the slow fall which followed, was very beneficial to the Basin Irrigation, as it enabled the feeder-canals to supply water for a long continued period of time.

The following is a comparison between the maximum flood levels reached at Aswan in the three lowest years of which records exist :—

Year	Maximum level at Aswan		Date
	Fies	Kirate	
1877	13	10	20th August
1899	13	22	3rd September
1902	14	0	17th "

Reducing these levels to English measure, the river (at Aswan) in 1902, was, at its maximum, about $1\frac{3}{4}$ inches higher than in 1899, and about 12 inches higher than in 1877.

The peculiar features of last year's flood, (which, it must be remembered, was the fourth bad one in succession) were the abnormally low levels which were maintained throughout the month of August and the late rise in September; at a period when, judging by previous years, all hope of an improved situation ought to have passed away.

The levels at the end of 1902 appear to indicate that the summer supply of 1903 will be no improvement upon that of its three predecessors.

It is evident from the foregoing, that very special measures were necessitated in order to secure the distribution of the scanty supply of water available. These measures followed very closely upon the lines of those introduced in 1900 and continued in 1901. These have been described previously, but for the benefit of those who may not have read my Reports for the two years in question, I will recapitulate them here.

Rice cultivation, except in certain selected localities, was practically prohibited, as the canal rotations were so arranged that all the available water should be devoted to the areas planted with cotton. These rotations, although not quite so severe as in the year 1900, were yet severe enough.

Earthen dams, to prevent the ingress of the salt water, and to act as storage reservoirs, were constructed in the Rosetta and Damietta Branches of the Nile.

The Delta Barrage was carefully regulated upon, so that no water should be wasted, and that full advantage should be taken of the first rise of the river. The Asyut Barrage was also partially closed during the summer, so as to secure the discharge required for the irrigation of Middle Egypt and the Fayum.

The Atfeh pumps, on the Rosetta Branch, were temporarily used to draw water from the river, and the volume of the Mahmudiyyeh Canal was thereby considerably increased. A special credit was granted by the Caisse, to meet the cost of the measures required for ensuring the distribution of the water.

Lastly, the Khedivial Decree, prohibiting the sowing of Maize, until such a date as permitted by the Public Works Ministry, was again issued.

Thanks to the foregoing measures, the summer irrigation of the "Sefi" tracts was successfully carried out, and no loss of crop occurred.

During the low flood, as far as Lower Egypt was concerned, no serious difficulties arose in the way of water distribution. This was entirely due to the Delta Barrage. Since the completion of the subsidiary weirs, it has been possible to regulate upon this work during the flood. In 1902, it was never fully opened at all. It stood a head, at one time, of as much as 2.5, metres and although there was slight displacement of the pitching in one or two places, no damage whatever was caused to the work.

In Upper and Middle Egypt, however, things were very different. Mention has already been made of the anxiety felt throughout the country, when the month of August passed, without any sign of a satisfactory rise in the water-levels. South of Asyut, it was impossible to do anything but wait. In this area, the basin irrigation is entirely dependent upon the supply in the large feeder canals which take off the Nile. At the time when these canals should have been running full, the river levels were so low that in many instances the water could not enter the canals at all. In none of them was a sufficient supply obtainable, and large areas of land remained without water until the timely rise in the latter half of September saved the situation. Had it not been for this, an immense extent of land must have remained unwatered. Even with this relief, it was only by extremely skilful manipulation of the supply, on the part of Mr. Clowes, the Acting Inspector General of Irrigation, that the irrigation of the lands was successfully effected. Great praise is due to this Officer and also to Mahmud Bey Sidky, the Inspector of the 5th Circle. The comparatively small area of "Sharaki" land testifies to their good work.

Mr. Verschoyle, in his Report, gives a long and detailed account of the measures taken to distribute the water in the different basin systems.

In Middle Egypt, i.e. north of Asyut, the levels of the Ibrahimiyah Canal, which is the main source of supply for this region, were so low that considerable uneasiness prevailed regarding the possibility of sowing the large area of Maize which is annually planted in the "Sefi" tracts, and in the newly connected basin lands of the Asyut Province.

Mr. Webb, who was at that time acting for me, promptly decided to lower the gates of the Asyut Barrage, which had lately been completed, and thus produce an artificial rise in the water-levels of this canal. He commenced this closure on the 10th of August, and by the 16th of that month, all the gates were lowered; Mr. Webb personally superintending the operation. By this means, the water-level upstream was raised 1.50 metres, and the discharge of the Ibrahimia Canal proportionately increased. The maximum level attained up-stream of the Barrage was 51.90, on the 19th of September, with a head of 0.97 metres. As the maximum level of an average flood here is 52.17, Mr. Webb's action converted what would undoubtedly have been a disastrous year for Middle Egypt, into one of fair flood.

It is difficult to estimate exactly the actual gain to the country as represented by the money value of the crops thus saved. It is certainly not less than L. E. 600,000, which sum bears a very large proportion to the whole expenditure upon the Barrage itself. This structure then, in its very first year of completion, repaid a considerable portion of the cost of its construction.

The gates remained down until the 19th of September, when the flood had reached its maximum, and anxiety regarding the irrigation had ceased. After that date they were gradually raised.

It is satisfactory to know that, although this work had only been completed a few months, it stood the severe and unexpected test without any damage whatever.

As in the case of the low summer supply, a special credit was asked for, and obtained, from the Caisse de la Dette to meet the cost entailed by the special works to avert "Sharaki."

I will now very briefly describe the principal points of interest connected with water distribution in 1902.

The Rosetta and Damietta "Sudds".

The Mahallet El-Amir Dam, on the Rosetta Branch, was constructed at the same spot as in previous years, but was designed to hold up

water 25 centimetres higher than in 1901. Its crest-level was fixed at 3.50 metres, and the water surface in the pool, above the dam, stood at R.L. 2.47. The width at top was 3.0 metres, with side slopes of 3 to 1.

For some three months this dam held up 2 metres of water and afforded a continuous "free-flow" supply to the canals on the east and the west of the river. It cost £E.9644 to construct. Work was begun on the 15th of January and completed by the 2nd of May.

The Fareskur dam, on the Damietta Branch, was constructed at a new site in 1902. As was mentioned in my last year's Report, the old site, north of Damietta, was not a good one. The river bed, at that place, is full of deep holes, in which the salt water lodges and consequently the whole reach becomes impregnated. The new site selected in 1902, was south of Damietta, and near to the village of Fareskur. The "Sudd" was built strong enough to resist a head of water of 1.50 metres, with the object of assisting the riverain canals, by feeding the the pumps situated on the Nile banks. The result was only fairly satisfactory. The springs and infiltration in this branch of the river do not, as in the Rosetta Branch, suffice to keep the reservoir supplied when the real period of stress arrives, and when all the pumps are drawing from it at the same time. The pond was filled to R.L. 1.42, but this level was only maintained for four days, and was only arrived at by passing a small discharge down the Barrage, and through the Mansura lock on the Mansuria Canal.

By the middle of June, the water level began steadily to fall and a supply sent down from the Barrage had but little effect. By the 27th of July, the level had fallen to 0.52 metres. Fortunately, as the position became critical, the rise of the river began. This dam was finally closed on the 26th of March, and cost £E.5000.

Sir H. Brown recommends that this dam should always be made in seasons of probable bad supply. He is right, as the tract of country bordering the river here, is very difficult to provide for, even with the improved distribution that will, in the future, be given by the completion of the Zifta dam. This "Sudd" not only keeps out the salt water, but utilises the available infiltration water and enables the engines and pumps on the river banks to work. It is true that it is apt to fail at a critical period, but notwithstanding this risk, it forms a valuable addition to our water supply.

I am of opinion that it will be advisable, when funds are available, to construct a permanent masonry structure on this branch. Such a work should not be a very expensive one, although a lock for navigation would be necessary. This work is not urgent, but it would probably

prove an economy in the end, as even when the Reservoir is in full working order, the Summer supply in the Damietta Branch, downstream of the Zifta dam, will always be a scanty one and it is indispensable that this reach of the river should be kept free from salt. Consequently, I think there are likely to be few years, in the future, when this dam can be dispensed with.

Canal Rotations in 1902.

As in the years 1900 and 1901, the programme for 1902 was a three-fold one, each change increasing the period of time between successive waterings. In Lower Egypt, the extreme period, fixed for last year, was 24 days, as against 28 days in 1900, and 21 in 1901. In Upper Egypt, the maximum was fixed at 26 days, but, as a matter of fact, this last severe rotation was not applied.

Sir H. Brown, in his Report, discusses the question of the length of rotations at considerable length, and in his remarks about the impossibility of avoiding long rotation periods in times of shortness of water, he has, I consider, amply proved his case. It is, as he says, a question of simple arithmetic, and long rotation periods are a necessity that is forced upon the Irrigation Service, and are not merely the result of choice.

A given quantity of water can only irrigate a given area of land. If the rotations are shortened, the water available will not go as far as if longer periods are imposed. There is no means of increasing the supply of water during the hottest months of the year, *i.e.* just previous to the arrival of the flood. Under such circumstances then, if the whole area under crop is to be saved, the water must be so carefully distributed that each tract gets its proportionate share. This share may be limited, and even less than is desirable, but there is no alternative, unless a portion of the area is to be sacrificed to the benefit of the rest. Where I do not think that Sir H. Brown's arguments are so strong, is when he attempts to show that these long rotations are not detrimental to the yield of the crop. He gives a table, showing the areas planted with cotton, in Lower Egypt, from 1894 to 1903. We may leave this last year out of the question, as the crop has not yet come to maturity; also, the years 1894 to 1898, for which he gives no figures, as regards the length of rotations.

There then remain the years 1899 to 1902. What are the figures ? In 1899, the average yield per feddan was 4·80 kantars, and the extreme rotation period 21 days, and *less*.

In 1900, the figures are 4·06 kantars, and 28 days.

In 1901. " " " 4·60 " " 21 "

In 1902. " " " 4·10 " " 24 "

We see from the above that, in 1900, when the rotation period was the longest, the yield per feddan was less, by 0·74 kantars, than in 1899, and by 0·54 kantars, than in 1901.

In the years 1899 and 1900, the areas planted were practically the same, but in the latter year the yield was less by 917,326 kantars. In 1902 again, *with a larger area planted*, the diminution in the yield was less than in 1899, by 726,625 kantars ; and, *with practically the same area*, it was less than the yield of 1901, by 637,911 kantars. It is true, as Sir H. Brown remarks, that climatic conditions have a considerable effect upon the yield of cotton. Still, as far as his comparison goes, I do not think that he has proved that severe rotation periods have but little effect upon the out-turn.

Personally, I hold the contrary opinion. Rotations, within reasonable limits, undoubtedly have a beneficial effect upon the plants, but if these limits are exceeded, I feel convinced that they must be detrimental to both the yield and the quality of the cotton. Among other evils, long periods of drought tend to induce cultivators to drench their crops, as soon as their turn comes for water. Excessive watering, more especially after long abstinence, and in great heat, is undoubtedly harmful to the plants. In my opinion, 14 days is the maximum period that the cotton plants can remain unwatered without detriment.*

Another evil is this. In times of great stress, the periods during which the crops remain without water is, in actual practice, frequently much longer than those laid down in the Rotation Programmes. The long reaches of canals, when closed off, take a long time to fill up, and the pumps begin sucking up the water as soon as it arrives, consequently, the lands at the tails of canals have, at times, to miss their turn altogether, and are sometimes deprived of water for 30 and even 40 days.

It is difficult to see a remedy, or how, in years of low supply, these severe rotations can be abandoned, more especially if rice cultivation is to be carried on at all. It does not appear likely that the area under

* This is equivalent to a 21 day rotation, i.e. water given for 7 days and cut off for 14 days.

cotton will decrease; the contrary is more probable. This being so, cultivators would do well to recognise that there is no option left to the Irrigation Service but to enforce severe rotations, at certain periods of the year, and that even the extra water obtained from the Reservoir will not obviate this necessity in years like the last three, of exceptionally bad supply.

The Atfeh Pumps.

These pumps were worked between the 2nd of July and the 6th of August, in order to supplement the discharge of the Mahmudiyah Canal. In all, 35,432,691 metres cube of water were lifted, at a cost of £E.1012.

£E.809 was used to pay for coal ordered in 1901.

This pumping station is being renovated, and new boilers are replacing the old and worn-out ones. The expenditure on this item in 1902, was £E.4354, not including £E.450 spent upon establishment.

Special Nile Credits.

In consequence of the abnormal conditions which ruled throughout the summer months, the Caisse de la Dette granted special credits, both for the low summer supply and for the low flood.

The following was the distribution :—

	£E.	MILL.
Special low Nile credit	11000	000
Special low flood credit	19300	000
Total... ..	<u>£E.30300</u>	<u>000</u>

The expenditure was :—

	£E.	MILL.
On low Nile credit	8655	735
On low flood credit	18095	635
Total... ..	<u>£E.26751</u>	<u>370</u>

There was therefore an unexpended balance at the end of the year £E.3548,630 mill.

These sums were expended upon the special low Nile measures already alluded to, and upon the works necessary for the prevention of "Sharaki."

“Sharaki.”

The following is the official return of the “Sharaki” area, as far as it has been ascertained at the time of writing:—

PROVINCE.	Full “Sharaki” Area.	Half “Sharaki” Area.
	Feddans.	Feddans.
<i>Upper Egypt:—</i>		
Aswan	13,807	2,733
Kena	69,638	36,539
Girga	12,020	6,256
Asyut	8,327	3,349
Minia	10,069	1,743
Beni Suef	2,986	536
Totals... ..	116,847	51,856
<i>Lower Egypt:—</i>		
Giza	11,816	7,133
Totals... ..	128,663	58,989

The following is a comparison of the unirrigated areas in the three lowest floods of which accurate records exist, viz., 1877, 1899 and 1902:—

UPPER EGYPT.		LOWER EGYPT.	
Year.	Area.	Year.	Area.
	Feddans.		Feddans.
1877	753,999	1877... ..	193,479
1899	229,422	1899... ..	35,394
1902	116,847	1902... ..	11,816

The totals thus become:—

1877	947,471	Feddans.
1899	264,816	“
1902	128,663	“

A very large portion of the unwatered area consists of islands and foreshores, for which nothing can be done in the way of preventive measures.

The "full Sharaki" area, for 1902, includes 16,000 feddans which were watered by wells, but upon which taxes were remitted.

CROPS IN 1902.

The Cotton Crop.

Notwithstanding the short supply in the river, the cotton crop of last year was a good one. It did not reach the total of the three best years, but it was above the average yield, since the general increase which commenced with 1890. The latest official returns, give a total of 5,750,000 kantars, but as there is still a certain amount in the Provinces to be brought in to Alexandria, it will most probably exceed this figure.

It would certainly have been larger had it not been for the cold weather and fogs which prevailed throughout the month of September.

The following is the comparison with the crops of previous years:—

YEAR.	Amount of Crop in Kantars.	Average price reached per kantar for the whole season.
		P.T.
1888	2,699,103	272·5
1889	3,200,000	268·0
1890	4,100,000	227·0
1891	4,500,000	178·0
1892	5,200,000	187·0
1893	5,200,000	178·5
1894	4,550,000	192·5
1895	5,203,650	223·9
1896	5,785,532	191·5
1897	6,513,144	162·9
1898	5,579,602	183·2
1899	6,432,776	258·2
1900	5,435,480	267·7
1901	6,369,914	217·8
1902	5,750,000 (about)	299·2

The foregoing figures include Upper, as well as Lower Egypt, but it is worthy of remark that, in the former area, the crop was a record one, as 472,000 kantars were ginned in the Upper Egypt Factories, beating all previous totals by 6,000 kantars. The area under cotton was 95,356 feddans, which is larger than any previous year except those of 1898 and 1901. As this gives the average yield at 4·97 kantars per feddan, it is probable that the area, as officially given, is understated.

The price of cotton, last year, was exceptionally high, the average price being higher than any obtained during the last 20 years or more.

The following gives the ruling prices at Alexandria for each month of the season:—

										Piastres per kantar.
September	1902	...	...	...	...	...	...	...	...	271½
October	"	...	...	...	...	...	...	...	...	244½
November	"	...	...	...	...	...	...	...	...	256½
December	"	...	...	...	...	...	...	...	...	280½
January	1903	...	...	...	...	...	...	...	...	291½
February	"	...	...	...	...	...	...	...	...	308½
March	"	...	...	...	...	...	...	...	...	326½
April	"	...	...	...	...	...	...	...	...	357½
May	"	...	...	...	...	...	...	...	...	359½

The contracts now being made, for next season's crop, are at an exceptionally high rate.

It is not, under the circumstances, extraordinary, that the price of land in Egypt continues to rise, seeing that, even in a bad year, such a yield is possible and such a price obtainable.

The Sugar Cane Crop.

This crop was rather below the average in 1901, and as is always the case when a large amount of cotton is planted the area under sugar was slightly less than usual.

The following statement gives the quantity of cane crushed and the out-turn of sugar, class No. 1, in the principal factories for the last seven years:—

	Soudan 1898-1901.			Soudan 1901-1902.			Soudan 1902-1903.															
	Cane attached.	Out-turn No. 1 sugar.	Percentage.	Cane attached.	Out-turn No. 1 sugar.	Percentage.	Cane attached.	Out-turn No. 1 sugar.	Percentage.													
Imam Sanikh..	38,815,112	1,200,362	10.1	14,478,346	1,230,373	8.5	14,080,044	1,233,525	10.2	14,515,505	1,309,858	9.4	11,950,485	1,103,471	9.8	12,442,432	1,245,843	10.0	11,146,491	1,098,105	9.9	
Imam Sultan Pasha..	57,467	55,589	9.1	151,300	36,310	8.1	179,822	43,885	9.1	465,627	42,659	9.2	524,466	49,469	9.4	410,165	40,230	9.75	505,493	46,892	8.98	
Société Génér- ale des Su- creries dans la Haute- Egypte.	3,799,062	39,551	10.4	5,008,806	601,434	8.0	6,250,350	5,978,871	3.75	40,540	3.6	5,978,871	43,508	9.2	81,816	9.6	—	—	—	8,004,787	795,555	9.9
Egyptian Su- gar & Land Company..	—	—	—	—	—	—	546,355	49,338	9.1	504,337	46,608	9.2	—	—	—	—	—	—	—	—	—	—
Imam-Koruh..	410,000	34,000	8.3	270,000	18,000	6.7	—	—	—	504,337	46,608	9.2	—	—	—	—	—	—	—	—	—	—
TOTALS..	69,419,541	2,054,195	10.1	10,298,317	1,689,317	8.3	13,065,141	1,376,216	10.5	13,969,136	2,054,637	10.4	13,439,223	1,979,337	9.8	26,506,165	1,098,889	9.4	14,719,309	1,870,629	12.2	

Within the last few months the Société des Sucreries has purchased all the Daira Sanieh Factories. With the single exception of the Daira Sultan Pasha, there is now but one Company in the whole of Egypt, and the sugar industry has practically become a monopoly.

"Qedi" or Summer Durah.

The area planted with this crop in 1902 was slightly less than in the two previous years. This is accounted for by the substitution of cotton for this crop in some of Beni-Suef Basins.

Maize and Winter crops.

The yield of these crops was good and the agriculturist in Egypt has good reasons to be satisfied with the result of last year.

DUTY OF WATER.

I discussed this question at some length in my last year's Report. My present remarks will be, in consequence, very brief. The duty for Upper Egypt is as follows :

PROVINCES.	TOTAL AREA OF CROP.	DUTY ON MEAN DISCHARGE. — Cable metres of water per feddan irrigated.
	Feddans.	
Asyut, Minia, Beni-Suef and Fayum taken together	173021	31·2
Minia and Beni-Suef (together)	90615	31·6
Beni-Suef (alone)	29291	23·9
Fayum (alone)	47142	33·9
Minia (alone)	61324	35·3

These duties are low, and show that there was little to complain of regarding the Middle Egypt summer supply. This is due entirely to the Asyut Barrage.

The difference in Beni-Suef, from the other Provinces, is striking, Mr. Verschoyle considers, and I agree with him, that, as there were no complaints from this Province last summer, the returns of areas under crop are probably incorrect.

Sir H. Brown works out the duty for Lower Egypt, as a whole, taking the supply available in the canals and river, and the areas returned as actually irrigated in 1902.

The figures are :

For rice 48·84 metres cube per feddan.
For other crops 24·42 " "

For the different Provinces the duty works out thus:—

PROVINCES.	DUTY ON MEAN DISCHARGE.
	Cubic metres of water per feddan irrigated.
Kalioubia, Sharkia and Dakahlia	24·6
Garbiyeh and Menufieh	24·2
Behera	24·46

This return is very satisfactory, and shows that the utmost use possible was made of the available supply.

As it is generally allowed that the crop areas, as returned by the Ministry of Finance, are below the actuals, Sir H. Brown thinks, and I share his opinion, that, allowing for an eighteen days rotation period, it will be safer to allow 30 cubic metres of water per feddan, for all crops but rice, and for this last, 60 cubic metres per feddan. This should be amply sufficient and if the supply falls below the above allowance, there will be nothing for it but to lengthen the rotation periods.

Nile Gauges in the Soudan.

Gauge returns are sent in very regularly, on the whole, from the stations where gauges were erected in 1900. Unfortunately, the Gondokoro gauge was washed away in November last, and the Tawfikia gauge was removed from the site at which it was erected in 1900. Owing to a misunderstanding as to the value of continual gauge records, the Fashoda and Tawfikia gauges have been transferred from one site to the other, and back again, more than once. The consequence is, that all the returns, previous to April 1903, are valueless for purposes of comparison. A new gauge has now been definitely erected at Tawfikia and it is much to be hoped that it will not again be moved. It is a most important gauge, as it records the increase in the White

Nile levels due to the Sobat river. The Nassir gauge (on the Sobat) is another very important one, but unfortunately, owing to the state of the river, navigation is stopped during the months when information regarding the rise would be most valuable, and is only received some months later. This is unavoidable, as Nassir is practically cut off from the world for some months of the year. Another valuable gauge, viz, Wadelai, does not reach Egypt for months after it has been recorded. As there is now a regular transport service between Wadelai and Gondokoro, it is to be hoped that arrangements may be found possible, whereby the readings of this gauge may be sent to Gondokoro, for Egypt, in time to catch the monthly steamer for Khartum. Early, in 1903, new gauges were fixed at Mongala, on the Upper Nile, and at the American Mission Station, on the Sobat. Another has been erected on the Atbara, near the point where the telegraph line from Khartum to Kassala crosses this river. These registers should be of great value to Egypt.

Sir H. Brown gives an interesting calculation of the time which the water takes to travel from Khartum to the Delta Barrage, at different periods of the year.

The results he obtains are follows :

In May the water takes 42 days to travel these 2,763 Kilom.	
In the first half of June 34 ..	
In the second half 32 ..	
In July..... 28 ..	
In September 14 ..	

Of course, the above are only calculated upon one year data, viz., the time taken in last year's flood.

The Victoria Nyanza Gauges.

As I shall discuss this question at length, in the separate Report which I am preparing upon my visit to the Equatorial Lakes, I shall not say much here. I will merely draw attention to the fact, that I satisfied myself, on visiting the different gauge sites, that all our previous comparisons of the Lake levels, based upon the three different registers supplied to us, are of little value, as the sites of the new and the old gauges are so far apart as to render any trustworthy comparison between them impossible.

It might perhaps be permitted to consider Entebbe and Port Alice, as one and the same site, as the distance is not very great between the

new and the old gauges, but as to the other two, it is out of the question to consider the readings as having any relation one with the other. For instance, we have been in the habit of considering the Port Victoria register, and that of Kisumu, as practically referring to one and the same gauge.

Kisumu (or Port Florence) is at the north-east corner of the Lake, in the Kavirondo Gulf, and shut off from the main sheet of water by a narrow passage, up which the wind blows with considerable force.

Port Victoria, is some 60 miles away, in another bay, on the north shore of the Lake.

Again, Lubwas and Jinja, although both of them are in the Napoleon Gulf, are some eleven miles, or more, apart, and the latter port is much more sheltered than the former.

It will then, in my opinion, be better, with perhaps the solitary exception of Entebbe, to reject for purposes of future comparison, all the old readings of Ugowe and Lubwas, and to commence our registers from the time when the new gauges at Kisumu and Jinja were erected.

All these gauges, at present, register different levels, and for purposes of comparison one with the other, are of little value. It is not at all probable that they will be connected by a line of spirit-leveling for many a day to come, but I think a great improvement on the present state of things might easily be made.

The three stations of Kisumu (Port Florence), Jinja and Entebbe are connected by telegraph. During certain months of the year, calms prevail on the Victoria Lake, more particularly in the early morning, about 8 a.m. It might then be arranged that, on a given day, when the telegraph announces calm weather at the three different stations, the gauges at each place should be driven down so as all to read the same depth of water. The readings might be compared for several days running, and corrected. This would not ensure perfect accuracy, but the zeros of the three gauges would more nearly approximate than at present. I intend to have some iron gauges made, and to send them to Entebbe for the purpose of having them erected in the Lake. I hope, when they arrive, that the above procedure will be carried out. It is unnecessary to say that the new gauges must be connected with the old ones.

If it is found impossible so to connect them, then it will be better, as far as Egypt is concerned, only to register the Jinja gauge, in future. This is incomparably the best site, being situated in a land-locked bay, and sheltered from the waves, while it has the additional advantage of being near the point where the Nile issues from the Lake.

The Kisumu site is by far the worst of the three, as the water rises in this Gulf when the west wind is strong, and the outlet being narrow, the water-level takes some time to fall again. Still, Port Florence is the only point on the Lake, connected by spirit-levelling with the Sea, and it will therefore be advisable to keep this gauge, and to connect it with the other two by the simple method that I have suggested.

It is worthy of note, that the water-level, at Entebbe, was as high in December last as it was in 1896, and nearly 2 feet above the level of 1900.

As regards the Albert Lake, there is only one possible site for a gauge at present, and that is on the small jetty at Butiabo. This is, I regret to say, about as bad a site as could well be selected, being exposed to the full force of the wind and waves. It is, however, the only place at which at present a gauge can possibly be read. The telegraph clerk, who lives within some three miles of the Lake, would, if he were paid a small monthly sum, read this gauge daily. I recommend then that a gauge be erected here, and that the Egyptian Government should pay for the readings. The information would be of some value, and certainly better than none at all. I propose to send a gauge for this place, with those for the Victoria Lake.

The "Sudd" in the Bahr El Gebel.

In the beginning of 1902, Major Matthews, of the Egyptian Army, commenced the clearance of that portion of the Bahr El Gebel, which still remained blocked by "Sudd," after the cessation of the work of previous years.

The clearance of this reach of the river turned out to be extremely difficult, owing to the entire absence of any current in the closed portion of the channel. It was, consequently, impossible to get rid of the blocks of cleared "Sudd," by floating them downstream, as had been possible in former operations.

Major Matthews worked extremely hard, but was obliged to stop work in the month of May, owing to the commencement of the annual rainy season. The work was therefore left unfinished. I visited the place in April, 1903, and, in my opinion, it is indispensable that this portion of the river should be opened up. The only alternative channel is a series of shallow lakes, in which navigation is difficult and may at any time become impossible. The loss of water from evaporation over this large surface is considerable, and if the Bahr El Gebel is ever to be induced, as I hope will be the case, to scour out its bed

and sides, it is absolutely necessary that its current, in this length of 23 miles, shall not be impeded, as at present. I therefore strongly recommend the resumption of the clearance operations in the autumn of 1903. If arrangements for the supply of fuel can be made before hand, and if work is begun in October next, there should be no impossibility in completing the work during the winter months of 1903-1904.

The expenditure on this work in 1902, was £E.1529,764 mill.

IRRIGATION EXPENDITURE IN 1902.

The following tables detail the expenditure upon Irrigation works, in 1902. The total disbursement amounted to £E.1443112,903 mill., omitting the sums paid to Sir John Aird for works connected with the Nile Reservoir.

TABLE I.

ORDINARY BUDGET.		£E.	MIL.
Central Office charges (including supplementary			
Reservoir expenditure...	...	73728	747
Upper Egypt ... ..	...	196885	959
Lower Egypt ... ..	...	349096	374
Total		<u>£E.619711</u>	<u>080</u>

TABLE II.

EXTRAORDINARY BUDGET.		£E.	MIL.
Zifta Barrage (Money granted by the Caisse)		209081	122
Drainage Works (Money granted by the Caisse) ...		68557	775
Irrigation Works (Money granted by the Caisse) ...		495937	233
Subsidiary Weirs at Delta Barrage)		2235	195
Total... ..		<u>£E.775811</u>	<u>323</u>

TABLE III.

VARIOUS SPECIAL CREDITS.		£E.	MIL.
Special Low Nile credit		8655	735
Special Low Floud credit		18095	635
Mahmudiyeh Canal dredging		4829	000
Rosetta et Damietta Sudds		13563	093
Barrage Gardens		919	271
Removal of Sudd in Bahr El-Gebel		1529	764
Total... ..		<u>£E.47592</u>	<u>498</u>

The figures in these three tables, added together, give the total expenditure upon Irrigation Works for the year.

TABLE IV.

TOTAL EXPENDITURE.							£E.	Mill.
Ordinary Budget	...	...	...	...	...	...	619711	080
Extraordinary Budget	...	...	...	...	...	...	775811	325
Various special credits	...	...	...	...	...	...	47590	498
Total...							<u>£E.1443112</u>	<u>903</u>

This is larger than the expenditure, under the same heads, in 1901, by £E.76465.759 mill.

The foregoing may be subdivided as follows :—

TABLE V.

	£E.	Mill.
(a) Regular Budget (including supplementary Reservoir Works) ...	201916	369
(b) Corvée Relief (from Caisse) ...	249999	370
(c) Corvée Relief (from Finance)...	150808	188
(d) Agricultural Roads ...	12393	387
(e) Special credit for Bridges to replace Ferries ...	4593	766
Total... ..	<u>£E.619711</u>	<u>080</u>

(a) The item "Regular Budget" in Table V is again subdivided thus :—

TABLE VI.

	£E.	Mill.
(1) Establishment ...	73344	876
(2) Contingent charges ...	20250	286
(3) New Works ...	11175	232
(4) Maintenance and Repairs ...	64785	694
(5) Khatatbeh and Atfeh Pumps ...	450	000
(6) Drainage of Lake Marcotis ...	10000	000
(7) Land charges ...	3889	391
(8) Supplementary Reservoir Works ...	18020	890
Total... ..	<u>£E.201916</u>	<u>369</u>

I will briefly discuss each of these items.

(1 and 2) Establishment and Contingent Charges.

These call for no special remark. The expenditure in 1902, was greater (in 1902,) by £E.1052.181 mill., than the similar charges for 1901.

(3 and 4) New Works and Maintenance and Repairs.

The expenditure under these two heads, is less, by £E.1471,012 mill., than in the year previous. No special remarks are called for, more especially as the works executed under these credits will be alluded to further on.

(5) Khatatbeh and Atfeh Pumps.

The sum of £E.450, appearing in Table VI. does not represent the total expenditure for the year; merely that portion of it which is charged the Regular Budget. It represents the salaries of the working staff. The working of these pumps and purchase of coal, cost £E.2272, while the alteration to the pumping stations involved a further cost of £E.4354.

(6) Drainage of Lake Mareotis.

Again, in this instance, the expenditure shown in Table VI does not represent the actual cost of working. A further sum of £E. 4400 was transferred from another item of the Budget, in order to meet the deficit which occurred in the season's working, thus bringing the expenditure for the year up to L.E. 14400.

(7) Land Charges.

These call for no remarks. There is an excess of £E.1385,657 over the expenditure for 1901.

(8) Supplementary Works connected with the Nile Reservoir.

These charges were less than those for 1901 by £E.1014,590 mill.

As before, they represent the cost of the supervising Government staff at Aswan and Asyut, and that of dredging the river at the latter place.

(b & c) TABLE V.—CORVÉE RELIEF.

These items call for but few remarks. The distribution of the credit furnished by the Caisse, was the same as that of 1901. The credit supplied by the Ministry of Finance, was, as usual, distributed according to the necessities of the different provinces and irrigation circles in which Corvée relief works were executed. The following table shows a subdivision of the Corvée expenditure.

TABLE VII.

	Upper Egypt.		Lower Egypt.		Total.	
	£ E.	Mill.	£ E.	Mill.	£ E.	Mill.
Money furnished by the Caisse ...	128000	000	121999	370	249999	370
Money found from Regular Budget	30302	715	120505	473	150807	188
Total... .. £ E.	158302	715	242504	843	400807	558

(d) TABLE V.—AGRICULTURAL ROADS.

The following shows the work done and the expenditure incurred:—

LOCALITY.	Length of roads existing previous to 1902.	Length of new roads constructed in 1902.	Expenditure in 1902.	
	Kilometres.	Kilometres.	£ E.	Mill.
Upper Egypt and the Fayum... ..	631	7	574	859
Lower Egypt... ..	1782	18·4	11818	528
Totals... ..	2413	25·4	12393	387

The apparently excessive expenditure in Lower Egypt, is almost entirely due to the payment of bills for land, taken up in the year previous but unpaid for, owing to delay in the preparation of the registers.

As will be seen from the above statement, progress in road-making has almost come to a standstill. The reason is, that, until some arrangement can be made whereby money can be found to keep the existing roads in thorough repair, it is useless to add to their length.

The maintenance charges in 1902, were as follows:—

	£ E.
In Upper Egypt	1050
In Lower Egypt	2853
Total... ..	£ E.3903 or an average of £ E.1·6 per kilometre of road.

This expenditure is quite inadequate to keep the roads in order. It means that only the worst portions of them are repaired in any one year and the rest is left until it gets so bad that repairs become imperative. The practice is not an economical one, but no other solution is possible.

(e) TABLE V.—BRIDGES TO REPLACE FERRIES.

The total expenditure under the Caisse grant, in 1902, was £E.4593,766 mill.

For this money four bridges were put in hand, two in Upper and two in Lower Egypt. Of these three were completed and the fourth is under construction.

In Behera Province, an iron bridge has been commenced at Khutatbeh to replace an old and delapidated existing bridge. £E.1000 was expended upon it in 1902, but it will require a further sum of £E.1600 to complete it.

In the Girga Province, 19 timber bridges on masonry abutments and piers, were built at a cost of £E.9420. These bridges are paid for by the landowners themselves, a tax having been imposed (voluntarily) upon the cultivated area of the Province in order to find the funds required.

Out of the 49 bridges voted by the Provincial Councils, 33 have been completed up to the end of 1902.

EXTRAORDINARY BUDGET.

The credits are granted by the Caisse de la Dette, and as their name implies, for works classified as "Extraordinary" i.e. not coming under the "Ordinary" heads of the Regular Budget. In the following brief description of the different works executed, the total expenditure upon "Irrigation" and "Drainage" does not correspond with that shown in the Table. In fact, it is considerably more, the reason being that, on these works, a large grant is annually added to that given by the Caisse, from the Regular Budget. Thus the funds for a large number of these works are partly supplied by the Caisse, and partly by the allotments of the Public Works Budget.

In discussing these works, I shall not attempt to separate the two charges.

DRAINAGE WORKS IN 1902.

The total expenditure in 1902, not including maintenance, was as follows:—

	£R.	MIL.
Upper Egypt	87501	000
Lower Egypt	64622	000
Total	<u>£E.152123</u>	<u>000</u>

To this should be added the amounts spent on pumping at Mex and Atfeh which equals £E.20216.

The total expenditure upon drainage in 1902, thus becomes £E.172339.

For this sum 527.5 Kilometres of drains were constructed and remodelled.

The principal drainage systems taken in hand in 1902 were the following:—

UPPER EGYPT.

(1) The West Yusufi drain extension. This is the drainage of the lands lying to the west of the Yusufi canal.

(2) The West Muhit system. This is a project for draining a portion of the converted basin lands into the Bahr Yusif. It is a channel, 10 metres wide, with a tail-fall into the canal.

(3) The Tagin drainage system is in the Fayum.

(4) The Etsa pumps. These pumps will lift the water drained from the Sefi lands and discharge it into the river.

These works are all approaching completion.

LOWER EGYPT.

In the Provinces of Sharkia and Dakahliya, the remodelling of the following system was continued:—

Rilbes, Neghir, Um Salama, Bahr El Bagar and Bahr Hadus.

In Gharbia Province, work was in progress in 1902 on the drainage systems of Banawan, Abu Nom, Abu Khashaba, Samatay, Waziria and Ariamun.

In Beliera, the Nubaria, Sorombay, Kafr Beni Helal, Umum, Gabbares and Khairi drains were perfected, including their branch drains.

With reference to this last Province, Sir H. Brown quotes statistics given by M. Williams, the Inspector of Irrigation, to show how, thanks

to improved drainage, the areas of cotton and winter crops have increased since 1894.

In this year, the area under cotton was 149,826 feddans. In 1902, it was 240,080 feddans.

The area under winter crops in 1894, was 268050 feddans while in 1902 it was 374,894 feddans.

Thus, the cropped area in Behera Province, has increased by nearly 40 per cent in the last eight years.

In the other Provinces, reclamation works have likewise increased the cultivated area, though not to the same extent. The reason being, that, in Behera, larger areas of reclaimable swamps existed than in other parts of the country.

Before leaving the subject of drainage, I would draw attention to Sir H. Brown's remarks regarding reducing the quantity of water carried off by the drainage channels. With these remarks, I am entirely in accord. The only possible way in which to reduce the over-flooding of the drainage lines is by controlling and restricting the supply of water in the Irrigation canals.

For the drainage of the low lying lands, bordering the Lake, he recommends the introduction of the system long in use in Italy and Holland, i.e. of running the drains at a high level through these tracts and pumping the water into them. This system was long ago advocated by Sir W. Willcocks. It is no doubt the most satisfactory way of draining these water-logged areas, and at the same time arranging for the successful drainage of the higher lands. It is, however, rather difficult to introduce into Egypt, where there is so little combination among the landowners, and where so many of the properties are very small. Nevertheless, the system is worth a trial.

PUMPING STATIONS FOR DRAINAGE IN LOWER EGYPT.

There are two stations of the kind: Kassassin in Sharkia and Mex in the Behera Province.

The Kassassin Pumps.

These drain the Wadi Tumilat, which will be described further on. £E.1797 was expended upon the enlargement of the station and the cost of pumping in 1902 was £E.4234.

The enlargement of the main pump drains cost £E. 2927.

The Mee Pumps.

The amount of water lifted by these pumps last season, showed no diminution upon that of 1901; on the contrary, an increase has to be recorded; 384,946,043 metres cube having been lifted in 1902 against 316,435,869 metres cube, the year previous.

This is the largest quantity yet lifted in any one year, and the expenditure was large in proportion. In spite of the reduced price of coal, it amounted to £E.14400. The mean height to which the water was lifted was 2.97 metres and the total coal consumption was 7169 tons.

The maximum quantity lifted in 24 hours was 3,278,520 metres cube.

To show how these pumping charges have increased, it may be mentioned, that in 1896 the quantity of water lifted was only 175,000,000 metres cube; in 1899, it was 285,000,000 cubic metres; while last year, it was 385,000,000 metres. Thus in each three-year period, there has been an increase of at the least 100,000,000 metres cube of water, lifted out of the lake into the sea.

This increase is entirely due to the improved drainage of the Province. In my last year's Report I pointed out, how heavy a charge this pumping was becoming upon the Irrigation Budget, and that, in my opinion, the landowners who have so largely profited by the altered condition should bear their share in the cost of improving their lands. As I discussed this question fully last year, I will not again do so, and will merely state that my opinions, as then expressed, are unchanged.

MAIN IRRIGATION IMPROVEMENTS, 1902.

The credits for the year were:—

	£E.	Mill.
Upper Egypt	412071	810
Lower Egypt	356879	334
Total	£E.768951	144

Of the above, £E.61697,594 mill. was supplied from the Regular Budget and the balance, viz, £E.707253,550 mill. was granted by the Caisse de la Dette.

In this table, the expenditure upon the new weir at Zifta is included, and the completion of the weirs downstream of the Delta Barrage.

I will very briefly describe the more important works executed in 1902.

UPPER EGYPT.

REMODELLING THE WEST YUSIFI BASINS.

These works have now been completed, at a cost of £E.211013, of which £E.19433 was expended in 1902.

The improvement effected in the land has been proved by the enhanced sums now paid for it by purchasers. For land in this tract, for which £E.10 to £E.15 a feddan would have been gladly taken some eight or ten years ago, the proprietors now refuse £E.50 to £E.60 the feddan. The taxes of this area are exceptionally low, and though they will eventually be reassessed, the Government will reap no direct return for the money spent on these lands. This project has been fully described in previous reports.

THE MAZURA LOCK AND REGULATOR.—BAHR YUSIFI.

Although this work, which has been described in previous reports, was completed in 1902, the total expenditure has been £E.55589, of which £E.2478 was spent in 1902.

THE MUHIT.

This has been already alluded to under the head of drainage.

It consists of an escape channel, 10 metres wide, discharging into the Yusifi canal by a tail-fall. At the head of the channel is a regulator, whereby the discharge of the escape can be diverted to the Nile, at Sharana, where there will eventually be erected a pumping station similar to that at Etsa.

THE WALIDIYEH SYPHON.

This work was described last year. It is nearly completed. The total cost is estimated at £E.4500, of which £E.3741, has been expended. The reason why this work was not completed last year is due to failure in the operation of sinking the iron pipes which form the syphon barrel. The bolts of some of the joists sheared, and the approach of the flood prevented a new attempt from being made.

WIDENING THE IBRAHIMIA CANAL, IN CONNECTION WITH THE BASIN CONVERSION.

A length of 40 kilometres has been completely finished and some new distributary works completed. The total expenditure up to date has been £E.67839, of which £E.39767 was expended in 1902.

NEW GATES TO DEIRUT REGULATOR.

A complete set of new iron gates have been erected on this important regulator. The cost of the work was £E.2497.

THE BENI KHALID AND HOSHAI TANAH.

This project consists of the construction of a canal through the Beni Khalid Basin and of Salibah with a regulator across the Tanah Basin. Both these works are for the purpose of ensuring the better distribution of the flood water. The expenditure was £E.7592.

REMODELLING WORKS IN THE FAYUM.

Excluding the Tagin drainage, upon which £E.17790 was spent in 1902, the principal irrigation improvement, in progress during last year in this Province, were the following:—

- (a) The Hassan Wasif Canal.
- (b) The Bahr Nezlet.
- (c) The Bahr Seilah and branches.

All these works were in progress in 1901, and were described in the Report for that year. The first two have now been completed.

(a) During the year just passed, a sum of £E.4655 was paid for land, bringing the total cost of the project to £E.61865.

(b) The works executed in 1902, were the completion of the 2nd reach of the Bahr Nezlet, and of the 3rd reach of the Bahr Kasr El Banat. Also, two falls on the Bahr Shellan. The expenditure up to date has been £E.67365 of which £E.9849 was expended in 1902.

MINOR PROJECTS.

A number of small works, such as bridges, siphons and aqueducts, for the better distribution of water, were constructed last year at a total cost of £E.6049.

CONVERSION OF THE ASYUT BASINS.

These works were practically completed in 1901, £E.42150 having been spent. This brings the total expenditure up to £E.177182.

M. Verschoye estimates that another £E.10000 will have eventually to be spent upon canal extension and irrigation outlets. This would give a rate of £E.3,233 per feddan reclaimed, exclusive of expenditure upon the main feeder canal and main drain.

This rate is undoubtedly very high, as it has hitherto been hoped that a cost of £E.2,005 mill. per feddan would be sufficient for the conversion. At the same time, no unnecessary expenditure has been incurred, and the result only shows how difficult it is, in estimating for a project like the present, consisting of a complicated series of systems of canals and drains, to accurately foresee the cost of the whole, or take into account the numerous details which experience proves to be indispensable.

An area of 4000 feddans was put under Sefi Irrigation in 1902. In one instance the cotton yielded 9 kantars per feddan. The area put under Maize was 36,000 feddans or 68% of the whole. It is said the average yield was 16 ardebs the feddan, and in some instances, reached the very high rate of 24 ardebs.

Heavy as the expenditure on these works has been, there is no doubt that it will prove to have been well warranted by the increased value of the land, and the produce.

CONVERSION OF THE SOUTH MINIA BASINS.

Three basins, covering an area of more than 53,000 feddans, were taken in hand in 1901, and completed by the beginning of August.

£E.140219 were spent last year, and the total estimated expenditure is set down at £E.239241 or a rate of £E. 3,163 per feddan.

The work done includes 509 kilometres of new channels and 230 masonry works. One chief cause of the high rate of expenditure upon these conversion works, is the enhanced rate of the land required for their construction. The value of land in Middle Egypt has been steadily rising since the Nile Reservoir work was commenced, and directly it was known that the remodelling works were to be undertaken the value of the land increased to a marked degree.

Water was admitted on to these lands in August last, but owing to the cholera epidemic, which at that time was very severe in Minia, a poor start was made, only 12,000 feddans of Maize having been culti-

vated. The winter crops were, however, excellent and every thing points to a good season in 1903.

CONVERSION OF THE NORTH MINIA BASINS.

The project for these works, comprising the conversion of an area of 56,200 feddans, was prepared and approved in 1902. The work will be commenced early in 1903.

The project for the conversion of the Beni-Suef Basins has also been approved of.

TALIHAT REGULATOR.

This work was completed during the year at an expenditure of £E.13000, bringing the total cost up to £E.25000. Unfortunately, an accident occurred during the flood which will entail an expenditure of another £E.6000. This accident was due in large measure to the carelessness of the engineer in charge and to bad work on the part of the contractor. The engineer has been dismissed, and the contractor's name struck off the list of those authorised to tender for Government work.

LOWER EGYPT.

The following were the principal works undertaken in 1902 :—

NEW REGULATOR AND LOCK FOR THE ISMAILIA CANAL.

In my last year's note, I remarked upon the defective work executed in connection with the well-sinking. This work has now been repaired, but only at a considerably increased cost. Sir H. Brown gives a detailed description of the methods used, and it will be sufficient to state here that by the end of last year, the structure was so far advanced as to warrant the assertion that it would be completed by April 1903. The total expenditure is estimated at £E.62417. This is a very high charge for such a work, and although due allowance must be made for the exceptionally bad nature of the foundations, I do not think that this work is one for which the Department can take much credit to itself. The expenditure in 1902, was £E.23239.

WIDENING SIRIAQOS REGULATOR, ON THE ISMAILIA CANAL.

This work consists in the addition of a new regulator, in order to increase the water-way. The new work is constructed as close to the old one as possible, without endangering the foundations of the latter. It is estimated to cost £E.9500 of which £E.5686 was expended in 1902. Progress last year was very slow, but the work should be ready for use in 1903.

DIMERA REGULATOR AND LOCK.

This consists in the remodelling of the old regulator and the construction of a new lock 24 metres long by 6 metres wide. The work was completed in 1902, at a total cost of £E.8011. Of this £E.6113 represents last year's expenditure.

THE ZULFICAR BRIDGE ON THE MAHMUDIYEH CANAL.

This is one of the swing bridges at the tail of the Mahmudiyeh Canal and in the town of Alexandria. Many years ago, these bridges fell into disrepair, and, after a long correspondence with the Municipality of the town, the Government decided to take the repairs in hand itself. The Pont des Ecluses was repaired in 1901 and last year the Zulficar Bridge was restored at a cost of £E.4829.

NEW WORKS ON THE RAYYAH BEHERA.

Of these, the only two under construction last year were, the enlargement of the canal head at the Barrage and the Nikla Regulator, some kilometres downstream. Both these works were completed in 1902.

The former was described last year. The work consisted of the construction of two additional openings to the Regulator, the complete remodelling of the old work and the construction of a new lock.

The work was one of the most difficult of those undertaken in recent years. The foundations were very bad, the head of water considerable, the springs very powerful and the new work had to be constructed in close proximity to the masonry of the existing structure, which was found to be of most inferior description, and built upon a design of which one can only say that it is a marvel how the construction ever stood at all. At one time, it seemed highly probable that the whole mass would collapse into the foundation pit, but thanks to the excellent

measures taken by Sir H. Brown and his staff, the danger was arrested and the work brought to a successful conclusion.

The total expenditure on this work has been £E.40384, of which £E.13912. represents the sum expended in 1902.

Messrs. Stent and Grieve deserve special mention.

THE NIKLA REGULATOR.

This, which is a large work of five openings, with a lock 35 metres long by 8 metres wide, has been completed at a cost of £E.26421. £E.9033 was spent last year.

DIVERS OTHER WORKS.

A further sum of £E.63977 was spent in Lower Egypt upon twenty-seven different works. These chiefly consisted in large remodeling of the canal system and thus ensuring a better distribution of water.

Many of these were important enough, notably the widening of the Sahel Markaz Canal in Behera, the Nigail Canal in Menufia and the Sisa Canal in Kaliubia.

Want of space forbids me to do more than make this brief allusion to them. To those desiring fuller information regarding these works, I would refer to Sir H. Brown's Report.

THE ZIFTA BARRAGE.

This work was practically completed in 1902. It was so far advanced by the end of the year, that the opening ceremony was held early in 1903.

It has been fully described in previous Reports, and Sir H. Brown gives, in his accompanying note, a detailed description of the year's progress, together with some excellent photographs of the work itself.

I will, consequently, very briefly describe what was done in 1902.

The pumps, in the foundation pit, commenced work on the 27th January and the whole of the cast-iron piling which surrounds the foundations was completed by the 8th of March.

In this period, 303 lineal metres of piling 16 feet in length and 411 metres of piles of 10 feet length were driven. The concrete in foundations, which was commenced on the 24th February, was completed by the 29th of March. The cube executed was 8,258 metres.

Fortunately, few springs were met with and none of them were formidable ones.

The floor was completed by the 4th of May, and by the end of July, all piers were brought up to the level of the springing of the arches. The cube of masonry in the floor was 17,424 metres. The clay apron, the filter bed and up and downstream pitching were also completed before the flood, while the lock walls and the east abutment were brought up to a level, one metre below that of the piers.

On the 31st of July, the southern dams in the river bed were cut and the river discharge allowed to pass through and over the season's work.

Progress, with turning the arches, was continued throughout the flood, and by the end of the year, the Barrage and lock were completed in all respects, with the exception of the parapet walls of the fences.

Considerable delay was experienced with the supply of iron-work of the lock and sluice gates, which did not arrive until long after the contract time had expired. Sir H. Brown, in his Report, comments severely upon this delay, and also reports unfavourably upon the quality of the iron-work, which was entirely supplied by two Belgian firms. This is a useful object lesson, as regards the practice, which is so general in Egypt, of accepting tenders for work on account of the low prices submitted.

The total quantity of brick-work in the Zifta Barrage was 25,817 metres cube. The expenditure up to date has been £E.265650, of which £E.144591 was expended in 1901.

It is pleasant to have to describe such satisfactory work as that done in connection with the Zifta Weir. The grant made by the Caisse was given on the 27th December 1908. As Sir H. Brown says, it was no mean feat to complete such a work within two years later. That this was done, is due to his own energy and skill, and to the way in which he was seconded by the Resident Engineer, M. Hurley, and the whole staff employed.

SUBSIDIARY WORKS IN CONNECTION WITH THE ZIFTA WEIR.

These consist of the canal heads taking off the east and west banks of the river above the Barrage, in order to enable the main canals to benefit by the rise in the water-levels upstream of the work.

On the west bank, is the new head to the Ablas Canal, so called after His Highness the Khedive of Egypt.

This head consists of four openings of five metres each and a lock thirty-five metres long by eight metres wide. The design is generally similar to that of Zifta and both works are calculated to resist a reverse pressure.

The expenditure upon this work and upon the junction canal, which is known as the Rayyah Abbas, was £E.59001 in 1902. By the end of the year all the arches were turned and the lock walls brought up to the level of the coping.

On the east bank, a commencement was made last year with the new feeder head and lock to the Mansuria Canal.

£E.5489, represents the expenditure incurred.

MINOR WORKS.

Among the many other minor works executed in Lower Egypt last year, only one, the Reservoir at Ezbet El Borg, need be specially mentioned here.

The work is for the purpose of supplying drinking water to the village of that name. When the Damietta Sudd is completed, the water in the Nile here is as salt as that in the sea itself. The inhabitants are entirely dependent upon the scanty supply in the canal and as was the case in 1901, at times suffer severely for want of drinking water. To obviate this hardship the reservoir in question has been constructed. The estimated cost is £E.7700, of which £E.5236 was expended in 1902.

The Reservoir is designed to hold 6,750 metres cube of water. It is entirely constructed of brickwork and no ironwork has been employed. It will be completed in 1903.

THE WEIRS BELOW THE DELTA BARRAGE.

These works rendered excellent service in 1902, as they enabled regulation to be continued on the Barrage throughout the entire flood season. They themselves held up from 2 to 3 metres of water most efficiently.

Downstream of the eastern weir, after the flood had passed, there were no signs of scour whatever.

On the western, or Rosetta Weir, two holes were scoured out. These were immediately filled up with stone, and no harm was done. Such repairs will doubtless be necessary, whenever regulation is continued through the flood. With such care and experience as is at present given, however, no danger to the weirs themselves need be anticipated.

These works were completed in 1901, but a few supplementary works remained to be carried out last year. These entailed an expenditure of £E.2235, bringing the total cost of these weirs up to

£E.434000. The estimated cost was £E.530000, so that an economy of £E.96000 has been effected upon their construction.

VARIOUS SPECIAL CREDITS.

Turning now to Table III, or works carried out from various special credits, I will for convenience repeat here the list of the works more especially referring to Irrigation, viz :

	£ E.	MIL.
(1) Special low Nile credit	8655	735
(2) Special low Flood credit	18095	635
(3) Dredging Mahmudiyeh Canal	4829	—
(4) Rosetta and Damietta Sudds	13563	—
(5) Maintenance of Barrage gardens	917	—
(6) Cutting the Sudd in Bahr El Gebel	1529	764
Total... ..	<u>£E.47590</u>	<u>134</u>

Of the above items (4) and (6) have been already described, item (5) represents the revenue obtained by the sale of fruit, etc., which is applied to the maintenance of the gardens, by permission of the Ministry of Finance.

Item (3) is the expenditure incurred upon dredging this canal, with a view to improving and assuring the water supply of Alexandria.

There only then remains items (1) and (2) to discuss. This expenditure has already to a certain extent been described in the preceding pages. In No. 1, the principal expenditure was that entailed by the cost of working the Atfeh pumps. These pumps worked for twenty days last summer. They raised 35,432,691 metres cube of water and supplemented the discharge of the Mahmudiyeh Canal by this amount. In addition the pumping station was repaired and improved by the purchase of new boilers. The total expenditure on these pumps in 1902 equals £E.5816. The balance of the credit was applied to special staff for enforcing rotations.

The expenditure on item No. 2, was entirely devoted to measures for the purpose of the averting Sharaki. The works consisted of new distribution channels, etc., and deepening existing ones, at the same time surrounding the higher portions of the "Hods" and river Sahels with banks and then effecting their irrigation.

WORKS UNDERS ORDINARY BUDGET.

The Barrage.

The total expenditure, under the Budget allotment for 1902 was £E.16777, or an excess of £E.263 over that of last year.

The following is the distribution :—

	£E.
Temporary staff	3359
River training	2672
New Works... ..	1180
Maintenance... ..	6861
Gardens... ..	1050
Asphalt paving	695
Model room... ..	960
Total... ..	<u>£E.16777</u>

Few of these items call for much remark. The River training is carried on steadily with a view to training it directly upon the two Barrages.

The Temporary staff is that employed upon working the gates and keeping the whole structure clean. New works, represent petty improvements to the Barrages. The Maintenance charges include those of the workshop, dredging, masonry repairs and painting and repairing the iron work.

The Gardens are an expensive item. As has been shown, £E.917 was received from the sale of fruit. This, added to the above expenditure, represents a total of £E.1967 for the year.

The area has been considerably increased. As these gardens are very beautiful and, in addition to affording a recreation ground to a large number of the inhabitants of Cairo, they are used for experiments in the introduction of new trees and plants into Egypt, I think the expenditure, large as it is, is fairly warranted.

In the Budget for 1903, I have reduced the maintenance allotment for the Barrage by £E.2000. This with the reduction of £E.1225 made in 1902, make the total reduction equal to £E.3225.

River and Canal Protective Works.

The expenditure in 1902 was as follows :—

	£E.
In Upper Egypt... ..	3683
In Lower Egypt... ..	38759
Total... ..	<u>£E.42442</u>

To this may be added :—

	£E.
Revetting canal banks (Upper Egypt)... ..	4392
Revetting basin banks " " " " " " " " " "	6894
Total... ..	<u>£E.53728</u>

This expenditure calls for no special remark. It merely represents the continuance of the work which has been steadily progressing throughout Upper and Lower Egypt for the last eighteen years.

Maintenance of Masonry Works.

	£E.
Upper Egypt... ..	15125
Lower Egypt... ..	18205
Total... ..	<u>£E.33330</u>

Earthwork executed in 1902.

The following are the dredging totals :—

LOCALITY.	Metres cube.	Cost.
		£E.
Upper Egypt... ..	108015	7302
Lower Egypt... ..	1475974	50207
Totals	1583989	57509

These cubes are considerably below those of last year. A very considerable economy has been effected in the cubes of dredging in the Rayyah Menafia and Behera.

Earthwork executed by hand labour in 1902.

LOCALITY.	Metres cube.	Cost.
		£E.
Upper Egypt... ..	9660478	116274
Lower Egypt... ..	9978901	181736
Totals	19639379	298010

The rate of work in Upper Egypt is considerably less per metre cube than in Lower Egypt. This is accounted for by the fact that the majority of work in the former locality is "dry," the reverse being the case in the Deltaic Provinces.

THE NILE CORVEE IN 1902.

The following are the figures, adopting the unit of 100 days :—

	£E.
Upper Egypt... ..	4706 men per 100 days.
Lower Egypt... ..	110 " " 100 "
Total... ..	<u>£E.4816</u>

In Lower Egypt, these men were employed in Gizeh Province only. None were called out, for the second year in succession, on the Nile banks north of Cairo.

The above are the lowest figures ever yet attained. Even in the year 1899, the numbers did not fall below 6596.

Satisfactory as is the above result, it must not be forgotten that last year's flood was a very low one. In any year of average high flood the number of watchmen must inevitably be increased. It is nevertheless satisfactory to know that, nowadays, the men are not called out *when they are not wanted*. This is certainly a step in the direction of progress.

THE WADI TUMILAT.

Sir H. Brown gives a detailed note upon the progress of this important experiment in land reclamation. I will extract a few of the points which I think of the most interest.

The original estimate for expenditure on reclamation works was £E.62819. By the end of 1902, a sum of £E.44267 had been expended, of which £E.8733, represents the charges for last year.

The progress has been good.

The enlargement of Kassassin pumping station is now complete, as is also the main outfall drain between the station and the Mahsama Lake. From this last point to Lake Timsah the drain still requires remodelling, which will include a new syphon under the Suez Branch of the Ismailia Canal.

Field and Branch drains were dug in 1902 for an area of 2700 feld.

There still remains an area of 700 feddans of uncultivated land to be drained.

Three regulating heads, for irrigation, were constructed last year.

Steam ploughs have been at work for six months breaking up the land, but progress is reported to have been but slow.

The revenue account shows the following:—

	£E.
Receipts	22859
Expenditure	21151
Surplus	<u>£E. 1708</u>

Part of this, viz., £E.115, represents the balance carried over for 1901. The net surplus for last year therefore is £E.1593.

The following comparison between the forecast made and the actual returns is interesting:—

ORIGINAL FORECAST.	Surplus.	Deficit.	Actual surplus.
	£E.	£E.	£E.
1st year... ..	—	3640	198
2nd year... ..	—	2150	314
3rd year... ..	350	—	720
4th year... ..	3150	—	1593
5th year... ..	4400	—	7000 } Estimate for 1903.
Totals...	7900	5790	9825
Deduct deficit...	5790		
	2110		

This shows that, even if the estimate for 1903 be considered exaggerated, that the actual returns up *to the end of the 4th year*, exceed the forecast, *to the end of the 5th year*, by £E. 715.

As the estimates are very carefully framed, it is improbable that, that for 1903 will not be realised. If it is, the then actual returns will exceed the forecast by £E.7715.

The year 1902, was the last of the first three-year period for which the lands were leased. In 1903, the leases have been renewed at higher figures and the rental will show an increase in consequence.

Again, a comparison between the land actually leased and that estimated in the forecast is of interest.

YEAR.	Forecast.	Actually leased.
	Feddans.	Feddans.
1898	8080	6917
1899	8000	7578
1900	9000	9382
1901	10000	12337
1902	11000	15200

It may be mentioned that the forecast for 1903, was 12,000 feddans, while 16,700 feddans have actually been leased by the end of February of the present year.

The yearly expenditure in maintenance has been higher than the forecast, but this is about entirely due to the pumping having cost more than was expected.

THE NILE RESERVOIRS.

Mr. Webb, in his attached report, gives a very full account of last year's progress on these works. His Note is so very clear that I shall refer anyone desiring information on this subject to it, and I shall confine myself to a very few remarks here. The work done last year was merely that of completion, the bulk of the work, both at Aswan and Asyut, having been completed in 1901.

Aswan.

At the commencement of 1902, only 69,000 cubic metres of masonry remained to complete the structure. By the end of July, this was

completely finished. Before the flood the whole of the sluice gates were erected and their working tested. On the 2nd of August boats were able to pass through the locks.

The quantities of permanent work executed, to the end of the year, were as follows:—

WORK.	QUANTITIES EXECUTED.		Total.
	To end of 1901.	During 1902.	
	Cubic metres.	Cubic metres.	Cubic metres.
Excavation	690,370	96,440	786,810
Masonry	475,812	69,631	545,443

The total payment made to contractor to the end of the year was:—

	££.	
Work done... .. .	2167808	
Less retention	33000	££.
		2134808
Land		29800
Grand total... .. .		<u>££.2164608</u>

Although the works were completed in 1902, these figures are not final, as by the specification, a final payment cannot be made until two months after the completion of the works.

FILLING THE RESERVOIR.

Owing to the low state of the river, it was decided to commence filling the reservoir works earlier than had been originally contemplated. On October 2nd, filling was commenced. By the 15th December 1902, the level of 104.00 was reached and by the 31st January 1903, the full level of 106.00 was attained.

Navigation on the river in no way suffered.

THE PHILE TEMPLES.

A full description was given last year of the works undertaken in connection with the preservation of these Temples.

By the middle of July 1902 the works were completed.

The total expenditure was ££.13839, or some ££.7000 less than had been estimated for.

THE ASYUT BARRAGE.

By the commencement of 1902, there only remained the parapet of this work to be done, and by the middle of February, it was completed and regulation commenced.

In another portion of this Report, I have shown how Mr. Webb, by his action in closing the gates of this weir in August last, saved the crop of Middle Egypt to a value of not less than £E.600,000.

The total expenditure upon the Aswan dam and the Assiut weir, including all charges, up to the end of 1902, has been Pounds Sterling.3269,505.

The inauguration ceremony at Assuan took place on the 10th of December in the presence of His Highness the Khedive, and their Royal Highnesses the Duke and Duchess of Connaught. The inauguration of the Asyut weir took place a few days later.

That these great works should have been completed one year in advance of the contract time, is greatly to the credit of all concerned.

I have so frequently mentioned the names of those to whom this satisfactory result is due, that I will not repeat them here, more especially as His Majesty the King of England, and His Highness the Khedive of Egypt, have both testified their approval by conferring Honours and Decorations upon those concerned.

THE IRRIGATION STAFF IN 1902.

I have, as usual, nothing but praise to bestow upon the staff of whose labours my present Note is a very brief record. The year 1902, like the two previous to it, was one of hard work for the Irrigation Service, consequent upon the low levels in the Nile throughout the year. In spite of this, a cotton crop, only surpassed in quantity by those of three years, was gathered. Also, the Sharaki area was less than in any similar year of low supply. These two facts speak for themselves, and are far more eloquent in the way of praise than any words of mine could be. Sir H. Brown, Mr. Webb and Mr. Verschoyle all laboured incessantly to secure the above results, while in addition to his work during last flood, Mr. Webb brought the work of the Nile Reservoirs to a successful completion.

In their efforts, these Officers were ably seconded by the Inspectors of Irrigation, Messrs. Langley, Dupuis, Williams, Clowes, Mahmud Bey Sidki and Hussein Bey Wassif. They again were efficiently supported by their respective staffs.

Of the junior Officers, perhaps the names of Messrs. Tottenham, Ireland, Wagborn and Hurley stand out the most prominently, but where all worked so well, it seems almost invidious to specially mention any name. Ismail Bey Sirri did excellent service in connection with the conversion of the Basins to Sefi Irrigation and in the preparation of the many projects which this great work entails. I recommend the entire Irrigation Staff to the thanks of Government for its work during 1902.

Part II.—WORKS OTHER THAN IRRIGATION.

I.—THE TOWNS AND BUILDINGS SERVICE.

The following tables show the sums expended by the above Service during the year 1902. They are merely an amplification of the details of the total expenditure, as recorded upon pages of this Report.

The following was the general distribution :—

	£E.	Mill.
(a) Ordinary Budget	210914	334
(b) Special credits, granted by the Caisse de la Dette ...	216641	149
(c) Special funds, derived from other Departments ...	22533	370
(d) Special works coming under the head of "Revenue" ...	9069	670
Total	<u>£E.459158</u>	<u>523</u>

This total shows an increase in expenditure over that of 1901 amounting to £E.22066,793 mill.

The four items in the first table are thus subdivided :—

(a) ORDINARY BUDGET.

	£E.	Mill.
(1) General Direction	21706	325
(2) Public Buildings	78282	362
(3) Cairo City	36372	439
(4) Provincial Towns	47733	849
(5) Lighting	24365	111
(6) Ezbekieh Gardens	2454	334
Total	<u>£E.210914</u>	<u>420</u>

The total is less than that for 1901, by £E.17441,691. The transfer of the Scavenging and Watering Service to the Sanitary Department, accounts for a large portion of this decrease.

I will briefly discuss the different items :—

(1) General Direction.

This calls for no special remark. The sum represents the salaries of the permanent staff and is less than that expended in 1901, by £E.884,929 mill.

(2) *Public Buildings*

The following is the distribution of expenditure:—

	£E.	Mill.
Temporary staff	835	661
General charges	5852	696
Materials and plant	871	178
New works	6182	234
Repairs and maintenance	64533	990
Total	£E.78282	362

Or, less than the expenditure, under the same head, in the previous year, by £E.1782,101 mill.

As I have in each Annual Report, for many years past, insisted at some length upon the insufficiency of the funds available for the maintenance of Public Buildings in Egypt, I will make my present remarks extremely brief.

The credits granted for the construction of new buildings are, thanks to the liberality of the Commissioners of the Public Debt and of the Ministry of Finance, amply sufficient, and have resulted in a very marked improvement in the number and character of the Public Buildings in this country.

In consequence of these grants, it has been possible to devote the greater portion of the works allotments, in the Ordinary Budget, to Repairs and Maintenance. This is a great step in advance, but even yet the Repairs allotment is ludicrously inadequate for the wants of the case. Although new buildings are gradually replacing the old ones, the number of these latter is still very great, and as construction must necessarily proceed slowly, it will be many years before the old buildings can entirely disappear. Meanwhile, they must be kept in repair. It should not be forgotten, moreover, that even in the case of new buildings, unless a certain annual sum is devoted to their maintenance, they will speedily, more especially in a hot climate, fall into disrepair.

(3) *Cairo City.*

	£E.	Mill.
Temporary staff	726	166
General charges	102	089
Plant and materials	1084	218
Transport of materials	5841	879
New works	2521	642
Repairs and maintenance	25293	445
Total... ..	£E.36372	439

The total exceeds that for 1901, by £E.8709,397 mill. In every item, except the first and third, there is an increase of expenditure.

These charges represent the cost of the up-keep of the Cairo roads, gardens, squares, etc., as well as the construction of new roads.

As in the case of repairs to buildings, the total expenditure falls far below what is required to really meet the requirements of the city of Cairo.

ROADS.

58,754 square metres of basalt road were constructed in 1902, bringing the total of roads made of this material, up to 374,692 square metres.

219,504 square metres of the old limestone road were repaired. 24,570 square metres of earth-roads were macadamised with limestone.

The total road surface of Cairo is 2,803,482 square metres, of which 1,392,526 square metres were macadamised by the end of the year 1902.

An experiment is now being tried, in the native quarters of the city, of substituting asphalt for macadam on the roads. The first cost of the former is high, being £E.1 per square metre, but by the conditions of the contract, the contractors are bound for this rate to maintain the road for a period of twenty years.

Mr. Perry, in his attached Report, gives figures to show that, although the first cost of an asphalt road is higher than that of a basalt road, the latter is more expensive than the former, in a life of twenty years, by nine Piastres the square metre. Another advantage in favour of the asphalt, is the greater facility with which a road made of this material can be kept clean and free from dust.

DRAINAGE.

An estimate has been prepared for extending the system of storm-water drainage, that was introduced in 1901, in certain quarters of the town. The cost of this extension amounts to £E.127200. This improvement must necessarily be postponed until funds are available.

Since the completion of the system now in use, the rainfall in Cairo has been so small that the new drains can scarcely be considered to have stood a fair test. There is little doubt, however, that they will fulfil expectation.

NEW ROADS.

A new road is in course of construction from Shubra to Rod El Farag, the port for the boats which ply upon the Nile.

A sum of £E.4951 has been spent up to date and the Tramway Service is extending its line along the new track.

Mr. Perry, in his Report, gives proposals and approximate estimates for new roads in Cairo, which should pierce the most crowded and unsanitary quarters of the city. These projects are all good ones, and would, if executed, vastly improve the hygienic condition of Cairo, but, as they are all costly, they will have to wait until other and more immediately urgent works have been carried out.

THE GHEZIREH AQUARIUM.

This was opened to the public in November 1902. The gate receipts, by the end of the year, were very small. In my opinion, it was not sufficiently well advertised. The gardens and the grotto are charming and the collection of Nile-fish is interesting and unique. I feel sure that, if Tourists, in the winter season, were aware of its existence, they would visit this place in considerable numbers.

MEASURES TO PREVENT THE SPREAD OF CHOLERA.

During the late Cholera epidemic, a good deal of work was done by the Tanzim Service, in the way of assisting the Sanitary Officers to combat the disease.

22 public water taps were erected in the short space of 16 hours. These were worked night and day by the Tanzim Officials. 334 wells were filled up by the same Service. The Bulaqia Canal, a most insanitary ditch, was filled in, from the point of junction with the Ismailia Canal, to the Shubra road.

NEW PROJECTS.

A scheme has been prepared for the construction of a wide and handsome boulevard, along the bank of the Ismailia Canal to Abbassiyeh, some 4 kilometres distant. This work is estimated to cost £E.25000, and as it would be an immense improvement to the town, it is to be hoped that funds for its construction, may shortly be forthcoming.

A project is in course of preparation for the construction of a new bridge across the Nile, connecting the Pyramid Road with Old Cairo, across the island of Roda. This work, with the necessary roads and subsidiary bridges, is estimated to cost some £E.230000. It is a most necessary work, as the existing bridge at Kasr El Nil is very narrow and quite insufficient for the increasing traffic.

Mr. Reboul, who is in charge of the Cairo Tanzim Service, has laboured incessantly for the improvement of the town, and deserves great credit for the success which he has attained, in the face of many difficulties.

(4) *Provincial Towns (Local Commissions.)*

	£E.	MIL.
Temporary staff	646	170
General charges	760	264
Materials and plant	101	608
New works... ..	159	924
Repairs and maintenance	16066	783
Total	£E.47733	849

The sums in the above table are expended by the local Committees of the Provincial Towns. These, again, are controlled by a permanent Superior Commission at Cairo, which examines all proposed expenditure, exceeding a certain fixed amount.

PROGRESS IN 1902.

The following towns are now supplied with electric lighting:—Mansurah and Helouan; at Ismailia, Suez, Tanta and Zifta, concessions have been granted for the lighting of the towns by electricity.

The contract for the lighting of Ghiza has been put up to adjudication.

Water works are projected for the following towns:—

Mansura, Damietta, Zagazig, Shebin-El-Kom, Menouf and Damanhur.

It is proposed to engage the services of a special engineer for the superintendence of the above works.

Pumps have been erected at various towns.

The funds at the disposal of the Committee have been largely devoted to the improvement of the several towns by works such as making new streets, squares, gardens, etc., etc.

On the whole, progress has been made.

(5) *Lighting.*

(a) *Gas.*

The total number of gas lamps, in Cairo, at the end of last year, was 3,500. This represents an increase of 257 during the year.

An additional grant of 2000 £E. was made. Mr. Perry states that this sum is sufficient for 298 lamps, for one year. It is not clear why 41 lamps short of this number were erected, more especially as he enlarges upon the urgency of increasing the illumination of the streets.

He hopes to induce the Cairo Gas Company to introduce the "Auer" incandescent burner in the place of the "batswing" burner actually in use.

A laboratory now exists, and accurate tests as to the quality of the gas supplied by the Company will in future be possible.

At the request of the Ministry of the Interior, the period of lighting the streets has been extended by half an hour. This has been done in the interest of public security.

The expenditure for the year, was £E.24365,111, as against £E. 19609,441, in 1901.

(b) ELECTRIC LIGHTING.

(i) *In Cairo.*

The Company have increased their sale of current, by 32 %, while the number of private consumers reaches 1180.

Eight kilometres of high and low tension cables were laid last year under the public roadways.

In order to permit the Government to arrive at a correct valuation of the capital cost of the Company's installation, a committee was appointed to examine their accounts.

These have been finally passed as correct.

The following public buildings in Cairo have been supplied with electric lighting in 1902:—

The Cairo Post Office, the Lunatic Asylum, the Survey Offices and Egyptological Museum.

(ii) *In Alexandria.*

This concession is granted to the same Company as in Cairo, but is controlled by the Municipality, instead of by the Ministry of Public Works. Mr. Perry criticizes the contract and working of the concession severely. Three serious accidents occurred in 1901 and 1902, in consequence of the system of high-tension overhead wires.

A code of regulations has been drawn up for the regulation of electrical installations in general. This was urgently required. It has been based on the latest European models.

(7) *The Esbekieh Gardens.*

In 1902, the receipts were £E.1183,593 while the expenditure was £E.2454,248. The deficit was £E.1270,655.

This was largely due to the cholera epidemic, during which both the English and native Military Bands were prohibited from playing in these gardens.

The Scavenging and Watering Service.

On the 1st of January 1902, the Service was transferred from the Public Works to the Sanitary Department.

(b) EXPENDITURE UNDER SPECIAL CREDITS GRANTED
BY THE CAISSE DE LA DETTE.

	£E.	MIL.
(1) Alexandria Tobacco warehouse	8177	917
(2) Egyptological Museum, Cairo, including transfer of collection	26924	011
(3) Sundry new buildings	171687	367
(4) Cairo storm-water drainage... ..	4326	750
(5) Rod-El-Farag Road	2558	596
(6) Repairs to ancient Arab monuments	2965	870
Total... ..	£E.216641	511

The expenditure under the last item No. 6, is described in a special report published yearly by the controlling Committee.

(1) THE ALEXANDRIA TOBACCO WAREHOUSE.

This work, which was described in last year's Report, was completed in 1902. The roof, flooring and columns were built in "Béton Armé".

THE NEW EGYPTOLOGICAL MUSEUM (CAIRO).

This fine building has at last been completed, and was formally opened by His Highness the Khedive, on the 15th of November, 1902.

The building is, on the whole, very satisfactory, and well suited to the purpose for which it was designed, but the lighting has given a considerable amount of trouble. The glass sky-lights cover a very large area (2,500 square metres) and not only cause too bright and ill-regulated a light, but cause the upper story to be intensely hot during the summer months.

Experiments are now being made to obviate these inconveniences.

The total cost of this building, including the transfer of the collection which cost to the end of 1902 £7892,297, has been £E.223,286.

In addition to the main structure, several supplementary works were undertaken in 1902. These comprised a house for the Director General, workshops, a boundary wall, police quarters and a monument, with a statue, covering the tomb of the late Mariette Pasha.

All these works, with the exception of the first and last, were completed last year.

(3) SUNDRY NEW BUILDINGS.

A sum of £E.171687, was expended in 1902.

I will give a brief account of the more important of the above.

The Arab Museum and Khedivial Library.

These are combined in one building, the former was completed in 1902, and the collection is now being transferred from its old quarters. The Khedivial Library was completed all but the main staircase. The transfer cannot, however, be effected until the new glazed steel dust-proof bookcases, which are to be ordered from Europe, have arrived.

The total expenditure upon this building up to the end of 1902 has been £E.54395. Of this £E.7382 was expended last year.

Model Workshop, Cairo.

This work was completed in October, 1902, three months before the contract date.

It covers an area of 2,650 square metres, and consists of shops for fitting, brass work, leather work, carpentry, coach building and painting; also the necessary stores and offices. It is designed to accommodate 100 artisans and 300 apprentices.

The total cost of these shops has been £E.15000.

Cairo Central Fire Station.

As was stated last year, the foundations, at this site, were exceptionally bad, the ground being honeycombed with old sewers and wells.

It was consequently decided to apply the system of "Béton Armé," or "ferro concrete" as Mr. Perry calls it, to them.

This system had been used with very satisfactory results in the adjoining Post Office buildings.

The foundations were completed in November last. The super-structure masonry has made good progress.

	£E
Expenditure to end of last year...	6644
" during the year ...	5531

Port Said Gouvernorat.

This building is almost completed and will be ready early in 1903.

It consists of a central block with two wings. The ground floor will

consist of offices and the 1st floor be the residence of the Governor General of the Canal.

The cost up to end of 1902 was £E.12759 of which £E.7803 was spent last year.

Port Said Summary Law Courts.

This was completed in December 1902, at a cost of £E.2852.

Port Said Post Office.

This will be completed in April 1903. The cost to end of 1902, has been £E.16656 out of which £E.11724 was spent last year.

The Sanieh School, Cairo.

The foundations for this School were extremely bad and "Béton Armé" was again used.

The work is now well above ground level, and is progressing rapidly. It is hoped that it will be completed in 1904.

The estimated cost is £E.36000, of which £E.8938 was expended to the end of last year.

The Cairo School of Law.

Here again, as is the case almost all over Cairo, the foundations were bad, owing to the mass of old sewers and cess-pits which existed in every direction. After excavation, the ground was well flooded, and afterwards the wells, etc., carefully filled up. A bed of dry concrete metal, 20 centimetres thick, was then rammed into the soil, and upon this the general bed of hydraulic concrete, 1½ metre thick, was laid. The masonry is now from 6 to 7 metres above ground level.

The total cost up to the end of 1902 has been £E.9867.

School of Agriculture, Cairo.

This is now completed and contains accommodation for eighty pupils. It covers an area of 2461 square metres.

On the ground floor are the class rooms and laboratories, the reading room, museum and drawing office.

On the first floor are the dormitory, infirmary, bath room, etc.

There is also a refectory containing dining room, kitchens and offices.

A house has been built for the principal costing £E.2004,588 mill.

Quarters have also been built for seven teachers.

The total cost of the above has been £E.21997,373, and the works were completed nine months before the contract time.

ASWAN WATER SUPPLY.

The Reservoir, pumping station and pipe mains, were completed in 1902, and the reservoir filled on the 1st of April.

The total cost has been £E.3135,768 mill. The engine (of 10 H.P.) is situated on the Nile, and the reservoir can be filled in three hours, pumping. The distance from the pump is 409 metres, and the water is delivered unto the reservoir at a height of 32 metres from the centre line of the pump.

The reservoir has a capacity of 100 cubic metres when full. It has a vaulted brick roof.

The earnings last year were £E.285.

Many other works, such as Police barracks, local schools, Government Offices, etc., were built throughout Egypt in 1902.

(4) CAIRO STORM-WATER DRAINAGE.

This work was fully described in last year's Report. It has been completed for the area selected for improvement, and the expenditure in 1902, was merely the closing of the accounts.

(5) THE ROD EL FARAG ROAD.

This will be alluded to, under the head of "Cairo Tramways."

(c) SPECIAL FUNDS PROVIDED IN ADDITION TO THOSE FURNISHED BY THE CAISSE.

The expenditure under this head was applied to a large number of small works. Many of them are too insignificant to detail in my Report. The following list mentions the more important works, but none of them calls for any special description. It will be noticed that, in some cases, expenditure is shown upon works, already mentioned in

the list of works executed from Caisse money. This means that, in addition to the Caisse grant, an allotment has been made by the Finance Ministry.

List of works executed under Special Funds.

	£E.	Mill.
The Government Printing Establishment	1923	—
Aswan water supply	1015	943
Iron railing for public gardens (Cairo)	1677	700
Mohamed Ali School	3548	221
Arab Museum (Cairo)	1377	168
Fire engines for Markaz buildings	828	116
Markaz Beltin	733	245
Repairs Kom El Shogafa Catacombs	774	425
Bridge Gafaria Canal	694	699
Cairo Native Courts of Justice	657	882
Damietta custom store	525	—
Abbas School	576	810
Markaz stables (Kena)	552	699
Furniture Mansur Palace... ..	579	988
Miscellaneous minor works	4067	774
Total	£E.25531	770

(d) SPECIAL WORKS COMING UNDER THE HEAD OF "REVENUE."

	£E.	Mill.
Cairo City	2846	114
Public buildings... ..	6007	588
Provincial towns	215	968
Total... ..	£E.9069	670

All the above are included in the expenditure already noted against the different buildings.

CAIRO ELECTRIC TRAMWAYS.

One new line was opened for traffic in 1902. It connects the Railway Station with the Kasr El Nil square via the Ismailia Canal. This line is a double one, and its length is $2\frac{1}{2}$ kilometres.

The track on the Pyramid line between the Kasr El Nil Bridge and the town of Ghizeh was doubled.

The overhead bridge, across the Upper Egypt line on the Pyramid road was completed in 1902.

The Government, in the course of last year, approved the project of a new line from Cairo Central Railway Station to the new Quay at Rod el Farag, on the Nile, below the Embabeh Bridge. A great portion of the track was laid in 1902 and it will be completed early in 1903. The total length will be about 4 kilometres.

The working of the Tramway lines has been very satisfactory.

The mean daily number of passengers using the lines, was 46,373 in 1902, as against 40,315 in 1901. This represents nearly 8 per cent of the population of Cairo.

	Metres.
The total length of existing single line	15,296
The total length of existing double line	20,947
Total... ..	<u>36,243</u>

The rolling stock consists of 95 motor cars and 59 trailers.

THE ALEXANDRIA TRAMWAYS.

	Metres.
The length of single track	13,820
The length of double track	33,428
Total... ..	<u>47,248</u>
Number of motor cars	50
Number of trailers... ..	50

The mean daily number of passengers using the lines in 1902 was 24,520.

THE HELWAN WATER WORKS.

	£ E.	MIL.
The receipts for 1902 were	3625	000
The expenditure was	2122	000
Gross profit... ..	<u>£E.1503</u>	<u>000</u>

The whole town is supplied directly from the mains.

GHIZEH AND GHEZIREH WATER WORKS.

	£ E.
Receipts in 1902	7368
Expenditure in 1902	4500
Gross profit... ..	<u>£E.2868</u>

In 1901, £E.500 was granted on an experiment for supplying the town of Ghizeh with water. The result has been satisfactory as far as it goes.

Against the above expenditure, the receipts were £E.188.

THE STAFF IN 1902.

The entire staff has worked well, and Mr. Perry has reason to be satisfied with the result of last year's work.

He has devoted all his energies to the administration of his Service, and this, in spite of much ill health.

In every country, by whatever name it may be called, the Service which directs and controls building operations, and improvements in towns, must necessarily be subjected to much criticism, and criticism which is, as a rule, hardly favourable. This is inevitable, as private interests are touched almost to an equal degree with public ones. The Buildings and Towns Service in Egypt has not escaped the fate of similar Services in Europe and elsewhere. Mr. Perry will, I know, be the first to allow that there is yet much room for improvement, but he has also the satisfaction of knowing that great progress has been made in every branch of his Service since he first took it over in 1897.

He specially brings forward the names of the following Officers and I cordially endorse his words of praise regarding each one of them.

Special Works.—Messrs. Clifton, Hewat, Pastour, De Cosson and Watson.

Tanzim.—Messrs. Said Bey Shukri and Schaufelle.

Repairs.—Messrs. Chapman and Ehrlich.

Cairo Town Service.—Mr. Reboul.

Water Works.—Mr. Curtis.

Electricity.—Mr. Jacot des Combes.

Gas and Cart Service.—Mr. Fitz Patrick.

Accounts Office.—Habib Effendi.

II.—THE SURVEY DEPARTMENT.

The following Table shows the expenditure for last year:—

	£E.	MILL.
Permanent staff	9593	605
Temporary staff and general charges	37709	680
Geological Survey	3275	882
White and Blue Nile measurements	1100	000
Miscellaneous (Reproduction of Maps)	2499	745
Total	£E.54178	912

This total is again subdivided thus :—

	£ E.	Mill.
Allotment in Public Works Budget	34005	912
Allotment given by Finance Ministry for the Revenue Survey	20173	000
Total	<u>£ E.54178</u>	<u>912</u>

The expenditure for 1902 exceeds that for 1901, by £E.12291,040.

Captain Lyons' Report is very full of information and detail. It will well repay study. Want of space prevents me from doing more than making very brief allusion to those points which I consider to be of the chiefest interest.

THE LAND SURVEY, GENERALLY.

In order to complete the work required, and to keep pace with the Reassessment Committees, it has been necessary to work at very high pressure and, as Captain Lyons remarks, "much higher than is good for the work turned out."

The final checking was in some cases hurried and insufficient. This is to be regretted, but it is difficult to see how it is to be avoided, as the Land Reassessment must be completed within a given time. The removal of the survey marks by the villagers has been the chief cause of delay, as it has necessitated large areas of country being surveyed a second time.

The District Authorities have been repeatedly addressed on the subject, but appear to be powerless to stop the practice.

On the whole, there has been a steady improvement in the class of work turned out and a small decrease in the cost, but as long as it is necessary to carry on the survey at such a rapid rate, it is hopeless to expect that any marked diminution in the expense can ensue.

Special progress has been made in the publication of Topographical maps. In 1901, 34 sheets were completed but not published. In 1902, 112 sheets were revised, making, with those of the previous year, a total of 146 sheets. Of these 124 were published last year.

The present credit of £E.2500, is quite insufficient for the production of Topographical maps at any approach to the rate at which they are required.

The Instruction class turned out 108 pupils in 1902, for the different branches of the Department.

Besides these, 31 resigned or were dismissed.

The sale of maps and publications has shown a steady yearly increase, the sum realised in 1902 being £E.1011, as against £E.141 in 1898.

During the year, 88,086 maps and 15,847 publications were issued free of charge, while 4,187 maps and 801 publications were sold.

The cost of the Revenue Survey of a square kilometre in 1902, was £E.7630, as against £E.9264 in 1901.

TRIANGULATION.

The minor triangulation of the Provinces of Kaliubia and Dakahlia was completed last year, as well as the greater portion of the major triangulation of Kena and Girga. In these last two Provinces, good progress was made with the minor triangulation also. Base lines were laid down and measured at Gebelain (Markaz Luxor) and at Ambir (Markaz Nag Hammadi).

1998 square kilometres of major triangulation were completed last year, at a cost of £E.938.

The total cost of minor triangulation in 1902, was £E.1430. For this sum, an area of 1,400 square kilometres was completed.

THEODOLITE TRAVERSING.

9253 kilometres were chained last year and 27,661 points fixed at a total cost of £E.2922.

This compares very favourably with the work done in 1901. In that year, the cost per square kilometre was £E.2200, whereas in 1902 it was only £E.1440, for the same area. This is the result of improved organisation.

THE REVENUE SURVEY.

At the commencement of 1902, work was in progress in the Provinces of Menufia and the Fayum. They were completed, though with difficulty, in time for the work of reassessment.

By the end of the summer the staff was at work in the Kaliubia and Dakahlia Provinces.

The total area surveyed in 1902 was 783,848 feddans, comprising 387 villages.

The average cost of this survey, per 100 feddans, including field work and records, works out in 1902, at £E.2100. In 1901, it cost £E.2582.

Captain Lyons gives an interesting table of the areas of holdings, which shows how largely the small plots preponderate.

THE COMPUTING OFFICE.

With regard to Captain Lyons' remarks upon the large amount of work done by the Computation Office in 1902, I must refer enquirers to his Report. I will only say here that the record is a most satisfactory one.

His note upon the compilation of Calendars is worth reading.

THE METEOROLOGICAL SERVICE.

The chief work of last year, consisted in organising and systematising the Meteorological Reports received from the different Observing Stations. By the end of 1902, arrangements were in progress for commencing a systematic measurement of the rainfall in the Delta and the Western part of the Mediterranean coast.

From the commencement of last year, monthly "résumés" of the weather were published, and forecasts were issued during the early and late months of the year.

The Observatory at Abbassieh will very shortly be transferred to Helouan, where a new building is in course of erection.

THE DRAWING OFFICE.

Mr. Hansard, the very capable Director of this Branch of the Survey Department, has succeeded in largely reducing the cost of map production. Thus, cadastral maps of a given size, now cost £E.0,720 per sheet, as against £E.1,725 in the year before.

Again, in the Topographical maps, there has been a large reduction in the cost of production.

150 copies of a single sheet containing 24 square kilometres, now cost £E.4,764, or 32 mills. per copy. This is about half of what the same sheets cost in 1901.

The staff of this Office consists of 21 Europeans, and 64 Egyptians. It turned out 5,487 maps and plans in 1902, as against 1,331 in 1901 and 874 in 1900.

Mr. Kearney, an expert in photography, joined the Department last year, and in 1903, photography will be employed systematically under his direction in the reproduction of maps and plans.

THE GEOLOGICAL SURVEY.

The arrangement of the Geological Museum occupied a great portion of the time of the staff last year. It is now nearly complete. In the winter and autumn of 1902, Mr. Beadwell continued work in the desert north-west of the Fayum and considerably increased the remarkable collection of fossil animals found at this site. A set of duplicate specimens from this locality were presented by the Egyptian Government to the Natural History Department of the British Museum.

THE LABORATORY.

A large amount of useful work was done in 1902 by Mr. Lucas, the Officer in charge of this branch of the Service.

In all, 362 samples were examined, of ores, building stones, cements, soils, etc., and fees to the extent of £E.116 were realised.

In this laboratory, physical as well as chemical tests are carried out. One of its principal objects consists in the testing of building materials, such as stones, limes, cements, etc.

A large stone-crushing machine has been erected.

The gas testing laboratory will shortly be in working order and in future, the gas of Cairo will be tested regularly.

Captain Lyons makes some remarks of great interest, regarding the adulteration of materials which is so prevalent in Egypt, and urges the more general use of analysis, in order to make sure that the article supplied is equal to that specified.

An extremely interesting article, written by Mr. Lucas, has been added as an appendix to Captain Lyons' Report, regarding the soil and water of the Wadi Tumilat.

There are many localities in which similar conditions rule to those existing in the Wadi Tumilat. Mr. Lucas' words are worth quoting in extenso:—"The Wadi Tumilat may serve also as a type of the only "
"way in which alkali lands can be reclaimed. There is but one "
"remedy and on the extent of the application of this, depends the "
"degree of fertility to which the land will ultimately be restored. "
"The remedy consists of thorough drainage and frequent washing. "
"Drainage alone is insufficient, and working without drainage is "
"useless."

"As supplementary aids to the restoration of the land to a satisfac- "
"tory condition of fertility may be mentionned, the special treatment "
"by chemical or other means of those parts where sodium carbonate "

“ is known to occur in excess, and the cultivation, in the first instance, ”
“ of plants that show a high degree of resistance to the particular ”
“ injurious salts that are found to be present. ”

“ The chemical amelioration of alkali lands consists in the applica- ”
“ tion of gypsum, as described in page 17; other means are the addi- ”
“ tion and ploughing in of sand, carbonate of lime, or lime. These ”
“ methods are purely physical and act by making the clay more friable, ”
“ more pervious to water, and hence more easily washed free from ”
“ harmful salts. ”

I recommend these words to all Egyptian Agriculturists. I would also draw attention to the remarks, in another portion of the same note, upon the injury caused to crops by the use of an excessive quantity of water for irrigation.

Lastly, I would draw the serious notice of the Inspector General of Irrigation, Lower Egypt, to the following sentence:—

“ Certainly, the maximum amount of soluble matter, in the Wadi ”
“ Tumulat drainage-water is very low and this must mean, either ”
“ that too much water is being used, or that the water is not doing ”
“ all the work that it is capable of, in removing the injurious salts ”
“ from the soil. ”

Measures should be taken as soon as possible to register the quantity of water lifted, daily throughout the year, by the Kassassin pumps. Without this record, it is impossible to definitely arrive at an accurate knowledge of the quantity of salts removed from the soil.

THE STAFF OF THE SURVEY DEPARTMENT.

Captain Lyons has rendered great service to Science as well as to Egypt. In addition to his survey and mapping operations, he has introduced a series of accurate observations, which are of the highest scientific value, and has so perfected his methods of observing, that Egypt now takes a very high place in the list of countries which compile meteorological statistics. He has been assisted by a staff of very capable men, most of them experts in their own particular branch.

I have already alluded to the good work done by Messrs. Hansard and Lucas.

The following Officers of the Department deserve special mention:—
Mr. J. Craig, in the Computing Office.

Mr. Humphreys, in the Revenue Survey, Mr. Dowson, in the Topographical Survey, and Mansur Bey Sidky, in the Observatory.

Messrs. Barron, Hume and Beadnell, in the Geological Survey.

III.—THE TECHNICAL SERVICE.

The expenditure for 1902, excluding the Government Arsenal, was as follows:—

	£E.	Mil.
Permanent staff	5524	825
Temporary staff	2912	457
General expenditure	841	554
Materials and plant	924	583
Repairs and maintenance of Government steamers ...	1930	842
Total	<u>£E.15134</u>	<u>261</u>

This exceeds the expenditure for 1901, by £E.721,362.

The details of the last item, are as follows:—

	£E.	Mil.
Cost of working steamers... ..	2083	769
Repairs and maintenance... ..	2797	060
Petty expenses	50	013
Total	<u>£E.4930</u>	<u>842</u>

This sum does not represent the real cost of the up-keep of these steamers, but merely that which appears in the Ordinary Budget. Thus, in 1902, the actual expenditure incurred was £E.7811.5, the difference being met from the Arsenal receipts, and the hire of the steamers themselves.

The Nile Fleet now consists of thirteen steamers, and even this number is, at times, insufficient for the requirements of the Service. Many of them are very old boats, and require a considerable annual expenditure in order to keep them in even an approximately serviceable condition.

The items of Permanent and Temporary Staff, etc., require no special explanation. They are practically the same as in previous years.

THE GOVERNMENT ARSENAL.

The value of work executed by the Arsenal, in 1902, amounted to £E.28357, as against £E.30474 in 1901.

The following is a distribution of the charges:—

	£E.
Work executed for Public Works Ministry	22504
" " " other Government Departments.	2966
" " " private individuals	139
Value of coals and engine room stores for steamers ...	2748
	<u>£E.28357</u>

The last item is included in the sum already mentioned as representing the cost of up-keep of the Government steamers.

The principal items in the charges against the Irrigation Branch of the Public Works Department last year, were 671 tons of steel pipes, 163 tons of cast-iron grooves, and 3,680 pieces of Regulating sleepers.

There has been a reduction of 21.8 per cent in the cost of steel pipes in 1902.

The rate, last year, was £E.12.27 per ton as against £E.15.7 per ton in 1901. This is due to the lower price paid for materials and also to the reduced cost of labour owing to the use of machinery.

The value of work executed last year for the Tanzim Service, was considerably below the average, owing to the transfer of the Scavenging and Watering Service to the Sanitary Department.

The Survey Department was supplied with iron triangulation marks, technical apparatus, office fittings, etc.

The machinery at the Arsenal was increased by a small portable hydraulic rivetter, a force pump and a small centrifugal fan.

The cost of materials bought for the Arsenal in 1902 amounted to £E.15982.

Of this :—

	£E.
Material ordered from local merchants	13623
" " " Europe... ..	2359
	<u>£E.15982</u>

The quantity issued from the stores to the workshop amounted to £E.15465 and £E.704 was issued to the steamers.

The total cost of labour in the workshops, exclusive of the foundry, was £E.5083.

Anis Bey gives an interesting account of the reduction in the rate of labour on iron and steel work, due to the introduction of labour-saving machinery.

YEAR.	Rate of labour per ton of steel pipes.
1899	2.48
1900	2.41
1901	2.03
1902	1.49

He, however, expresses the opinion that the limit of economy of labour has been reached in this direction.

THE CENTRAL STORES.

Value of instruments and camp equipments purchased in 1902:—

	£E.	Mill.
Purchased in Europe	485	010
Purchased in Egypt	464	983
Made in Arsenal	287	771
Total... ..	£E.1237	764
Repairs to instruments	338	359
Total... ..	£E.1576	123

Articles to the value of £E.1791,025 mill. were delivered from the central stores last year.

THE STAFF OF THE TECHNICAL SERVICE.

I have nothing but praise to give regarding the manner in which the Director, Mohamed Bey Anis, has controlled and worked the important branch of the Service of which he is the Administrator. The Egyptian Government possesses few better or more efficient servants than Anis Bey. He was very well seconded by his two principal assistants, Mr. C. Crawley, who is in charge of the Steam Engine Service, and Mr. H. Curtis, who is at the head of the Government Arsenal.

IV.—THE MUSEUM AND ANTIQUITIES DEPARTMENT.

The expenditure for 1902, under the Regular Budget, was as follows:—

	£E.	Mill.
Permanent staff	7269	806
Temporary staff	3031	231
General expenditure	2883	477
Total... ..	£E.13184	514

Each of these items shows an increased expenditure over that of the previous year, the total excess amounting to £E.849,159 mill.

To the foregoing is added:—

	£E.	Mil.
Receipts from Tourist fund	3796	500
" " entries to the Museum	625	550
" " sale of objects	926	610
" " sale of "Sebakh"	378	582
" " sale of publications	242	670
Total... ..	£E.5969	912

It is satisfactory to note that, with the exception of the fourth, all the above receipts show an increase over the figures for 1901. The total increase amounts to £E.717,157 mill.

This expenditure is controlled by a permanent Committee, of which the Director General of the Antiquities Service is the President.

As in 1901, a sum of £E.4000 was granted by the Caisse de la Dette, for the compilation of the Museum Catalogue and for the repairs to the Karnak Temples.

The expenditure on the latter work was £E.1899,599 in 1902, the balance being devoted to the production of the Catalogue.

By far the most important work of last year, was the transfer of the collection from the Giza Museum to the new building in Cairo. Preparations for this work were commenced some two years before, and a temporary line of railway was laid down, connecting the two buildings. The removal of the cases commenced on the 3rd of December 1901, and by the 13th July, the last train-load of objects was removed from Giza.

By the 10th of September, the collection was arranged and classified in the new building, and on the 15th of November, the Cairo Museum was inaugurated by His Highness the Khedive.

Mr. Maspero gives a long and very interesting account of this work in his attached report. I will only say that the completion of such a work, in such an incredibly short space of time, and, moreover, without any loss or damage to the collection, reflects the highest credit upon Mr. Maspero and his whole staff. He personally superintended every detail, and to him and all concerned, the thanks, not only of the Egyptian Government, but of all interested in Archeology, are due.

The sum allowed for this transfer, in the estimates, was £E.8500. By the end of last year, £E.7892,297 had been expended.

I will briefly indicate those points in Mr. Maspero's report which seem to me to be of the greatest interest, but the report itself is well worth perusal. It gives a very full account of the work done by the Service in 1902.

As was the case last year, Monsieur Maspero draws attention to the damage which regrettably continues at many of the sites. In some cases, this damage is merely due to the natural causes of decay, and in the case of Beni Hassan to an accident, viz, a violent storm, which filled the tomb in December last.

In one case however, he reports wanton damage, a European lady visitor having destroyed a portion of the painted pavement at El Amarna with her umbrella!

He also notes the fact that the vibration, caused by the steps of the large number of tourists who yearly visited the Royal tombs at Thebes, is slowly but surely causing damage to these monuments, by causing portions of the frescoes on the walls and roof to fall down.

212 watchmen are employed upon the monuments in the Provinces, at a cost of £E.2853,600. Even this number is reported as insufficient, and in spite of the activity of the Inspectors, illicit digging still takes place to a large extent. In many localities, organized bands of thieves exist, who, at times, do not hesitate to show fight when surprised by the guardians of the sites.

The principal repair works executed last year, were at Karnak, Abydos and Edfu. At the two latter places, iron girders were introduced into the roofing, but at Edfu, the stability of the building is threatened, and repairs upon a considerable scale are to be undertaken in 1903.

At Karnak, the foundations of eleven of the fallen columns were rebuilt, and in the last week of December 1902, a commencement was made with their reconstruction.

Repairs to the superstructure of the Philæ Temples were also carried out, at a cost of £E.674,366. These repairs, which chiefly consist of cement pointing, can hardly be considered as adding to the beauty of these building, and, moreover, have been introduced in places, many metres above the highest level that the water can ever possibly reach. Mr. Maspero states that the sand-stone blocks, which are now inundated by the water of the Reservoir, absorb water with a disquieting rapidity. In places, the damp has risen by capillary attraction some two metres above the highest water-level.

Some damage was caused last year, by tourists endeavouring to pass through portions of the Temples in boats. This practice will not be permitted in future.

£E.2139,466 was expended on the repairs to 18 monuments, excluding Karnak and Philæ.

Electric light has been installed in the Royal Tombs at Thebes, at a cost of £E.649,092.

A new law, regulating the different questions connected with antiquities in Egypt, was drafted in 1902. At the end of the year, this was still under consideration by the Government lawyers, but it is probable that it will be presented to the Egyptian Government in the course of the current year.

In order to apply this law to Europeans, the consent of all the Powers (14 in number) will be required. Experience has proved that this consent will necessitate a very considerable lapse of time to obtain.

Monsieur Maspero gives a long account of the progress made, in the way of excavation, last year, both by private Societies and individuals, and by the Museum itself. Some interesting finds were made, among them fourteen Colossi, one of them of an unknown King, at Karnak, and the tomb of one of the earlier Kings at Saïara. I would refer anyone desiring information upon this portion of last year's work, to Mr. Maspero's Report.

Considerable progress was made with the Museum Catalogue last year. Four new volumes have been published, viz: "Vases en Faïence," "Greek Pottery," "Royal Tombs and Monuments" and "The stele of the Middle Empire."

Five other volumes are in the press and six more are in course of preparation.

THE STAFF OF THE ANTIQUITIES DEPARTMENT.

Of Monsieur Maspero's own services it is scarcely necessary to speak. His reputation both as an Egyptologist and as an Administrator is so high, and is of such long standing, that any words of praise from me would be superfluous. I will content myself by saying that, since he returned to Egypt and took over charge of the Service, some two years ago, the improvement in the working of every branch has been remarkable.

He has a very capable staff to assist him. Among them I may specially mention the following names:—

Mr. Quibell
Mr. Carter
Mr. Brugsch Bey
Mr. Basile
Mr. Daressy
Mr. Barsanti
Mr. Legrain
Ali Eff. Habib
Mahmoud Eff. Mohamed.

The permanent staff employed upon the Catalogue consisted of Messrs. Von Bissing, Edgar and Lacau. The following Gentlemen kindly lent their assistance during last winter: Messrs. Newberry, Spiegelberg, Daressy and Ahmad Bey Kamal.

V.—AGRICULTURAL RAILWAYS.

Only thirty-seven and a half miles of new line were added in 1902, but eleven more were under construction at the end of last year.

The total length of existing lines on the 31st December, 1902, was 663 miles. Applications have been received for 312 miles more. A steady improvement is manifest in the traffic receipts, (both coaching and goods) in two of the Railway Company, viz, the "Mansoura-Mataria" and the "Delta Light Railways."

The total receipts for the three Companies were as follows:—

NAME OF COMPANY.	No. of passengers carried.	Coaching receipts.	Tons of goods carried.	Receipts on goods.	Total receipts.
		£ R.		£ R.	£ R.
(1) Mansoura-Mataria ...	617,448	14477	55,008	7380	21936
(2) Delta Light Railways ...	3,311,448	66001	463,928	47290	125610
(3) Fayum Railways ...	439,993	6705	75,550	4969	12130

The above figures, as regards the first two lines, show a considerable increase over those of the previous year and prove that these lines meet a great public want. They are not only a convenience to those who use them, but a real benefit to the country.

The rates of increase are as follows:—

	Increase in passenger traffic.	Increase in goods traffic.
Mansoura-Mataria Railway ...	4 per cent.	19 per cent.
Delta Light Railways ...	9 " "	17 " "
Fayum Railways ...	No returns were given for last year.	

The total yearly receipts upon the Mansoura-Mataria line have risen to £.£.320 per mile, and to ££.253 per mile, upon the Delta Light Railways.

The ratio of working expenses to gross receipts shows, in two instances, an improvement upon the year 1901.

	Ratio of working expenses to gross receipts	
	1901	1902
Mansoura-Mataria Railway.	55.8 per cent.	55.0 per cent.
Delta Light Railways... ..	72.0 " "	61.5 " "
Fayum Railways... ..	80.8 " "	92.5 " "

Each Company has tried to increase the coaching traffic by reduction of the passenger fares. The experiment has not been altogether successful, and it would appear that the lowest limit in this direction has been reached. The Delta Company has been obliged to revert to the higher rates.

Both the Delta and Mansura Companies are now in a flourishing condition, and compare favourably with similar systems in Europe.

As regards the Fayum lines, it is impossible to give so good a report. This is much to be regretted, as this is the first instance of a purely native Company existing in Egypt.

TELEPHONES AND TELEGRAPHS.

The Mansura-Mataria Company, and the Fayum Company, have a good system of telephones throughout. The Delta Company has a partial system of telegraphs, to which they added 55 kilometres last year.

CONNECTION WITH STATE RAILWAYS.

Through booking is now allowed to the companies with the State Railways, and transshipping platforms, to facilitate the transport of goods, are being erected at certain points. Mr. Gunn points out that a great deal of traffic is lost owing to the delays at the joint stations. These are probably due to want of cooperation.

ACCIDENTS.

No accidents to passengers have been reported, although several of the employes have been killed during the year.

VI.—THE ZOOLOGICAL GARDENS, CAIRO.

This garden was transferred from the Ministry of Finance to that of the Public Works in June, 1901.

The total receipts were as follows :—

	£E.	Mil.
Balance credit for 1901	81	632
Government grants	3913	000
Gate receipts	1028	630
Miscellaneous, etc.	43	271
Total... ..	£E.5066	533
The expenditure was... ..	£E.4875	147
Balance to credit	£E. 191	386

There was a large falling off in the gate receipts last year, owing to the prevalence of the Cholera epidemic in Cairo, throughout the summer months.

A good deal was done in the way of improving the buildings and affording better accommodation for the collection.

A "Tropical house" was built. The Bears' house was altered and repaired, new cages for the Birds of Prey were constructed, and a large amount of alterations and repairs was executed on the different sheds and paddocks.

The number of animals, alive in the gardens at the end of last year, was 923, comprising 211 species.

338 additions were made to the collection in 1902, of which perhaps the most important were an Addax, a Leucoryx, three Whale-Headed Storks and two Secretary Birds.

In January 1902, ninety live animals were despatched from the Soudan to Giza, of which eighty-eight reached the gardens in safety.

Captain Flower, the Director of these gardens, has done wonders in the way of bettering the condition of the animals and birds under his charge, of improving their accommodation, and in adding to the collection. He has devoted his whole time and energy to this work, and the result is extremely satisfactory.

I hope that, in time, these gardens may develop into a fine collection of purely African animals. There is no doubt that such a collection would be of immense interest, and might be developed in Cairo, without serious difficulty, if only funds were forthcoming. It is to be hoped that some day, the artificial lake may be turned into a Hippopotamus pond, and that a new reptile house and a new monkey house may ere long be constructed.

VII.—THE CENTRAL OFFICE.

The following is a detail of the expenditure:—

	£E.	Mill.
Permanent Staff	24824	709
Temporary Staff	1981	856
General Expenses	4149	941
Material, furniture, etc.	12	100
New works	10602	689
Total... ..	<u>£E.41570</u>	<u>695</u>

This shows a reduction of expenditure, as compared with 1901 equal to £E.1101,356. Only the last item in the above requires special remark. The charges are thus described:—

	£E.	Mill.
Cairo Opera House subvention and Staff	6121	200
Maintenance of above	1275	959
Zoological Gardens	2159	000
Arab Monuments	925	930
Sundries	120	000
Total... ..	<u>£E.10602</u>	<u>689</u>

The expenditure shown above for the Zoological Gardens does not represent the total. In Captain Flower's report, he has included the cost of the new works, which appear, most of them in another place, under the head of Public Buildings.

THE STAFF IN 1902.

Monsieur Boinet Bey, the Secretary General, has continued to render me the most valuable assistance. He is a most efficient addition to the staff of the Department.

As regards Mr. Farid Bey Babazogli, the Chef du Service Administratif, I can only again say what I have said yearly in these Reports, that he is quite one of the most hardworked and capable servants of the Egyptian Government.

The staff, as a whole, has worked hard and fairly well.

W. E. GARSTIN.

*Under Secretary of State
for Public Works.*

Cairo, the 14th June, 1903.

ADMINISTRATION REPORT
OF THE
IRRIGATION DEPARTMENT IN UPPER EGYPT
For 1902

BY
K. E. VERSCHOYLE,
INSPECTOR GENERAL OF IRRIGATION, UPPER EGYPT.

ADMINISTRATION REPORT OF THE IRRIGATION DEPARTMENT IN UPPER EGYPT FOR 1902.

Part I.—IRRIGATION AND DRAINAGE.

SECTION I.—THE NILE.

The level at Aswan on the 1st of January was R.L. 86.86 which is At Aswan. 0.81 below the average for the 30 years, ending 1892, and, with the exception of the 1st of January 1899 and 1900, the lowest level on record for that date. It was however better by 97 centimetres than the record low level which occurred on the 1st of January 1900.

The rate of fall was about normal up to the 6th June when the minimum level of 84.43 was reached. This minimum level is 0.58 below the average, and was reached 11 days later than the average date.

The rise at first was fairly satisfactory, the level reached on 1st July being 85.42 against 85.10 in 1900, and 85.24 in 1899. From this date on the rise became slower and slower, and on 21st of July, the gauge only recorded a level of 86.66, the lowest level on record for that date. On the 15th of August the level reached was 89.42 which was 1.44 metres below the level for the same date in the record low years of 1877 and 1899. Matters now looked very serious as regards basin irrigation in Upper and Middle Egypt as little appearance of improvement was shown by the Southern gauges. However, from the 16th of August the Blue Nile began to rise fairly rapidly, and on the 3rd of September the Aswan gauge reading was only 15 centimetres lower than that for the same date in 1877 and 54 centimetres lower than that for the corresponding date in 1899.

From the 3rd of September matters began to improve rapidly and by the 8th of September the curve traced by the river levels at Aswan had crossed that for 1877 and reached that for 1899. Seven days later the curve for 1888 had been crossed, and the level on that date was in advance of those for the three years of previous minimum floods. The maximum reading of 14 Pies or R.L. 91.72 was reached on the 17th

of September. This maximum was 1·18 metres below the normal. The level now held up well and the fall was gradual. The curve traced by the levels of 1901 was crossed on 5th of October, and on 20th of October the levels for 1900 and 1902 coincided. In other words on 5th of October the level was only 81 centimetres below the normal against 2·67 metres below the normal on the 17th of August.

From the 20th of October the fall was normal. The level on 31st of December was 86·55. This is 1·12 below the normal, and the lowest on record with the exception of 1899. A start however was made with filling the Aswan Reservoir on the 20th of October, so the levels recorded by the Aswan gauge after that date are not comparable with those of previous years. Judging from the levels recorded by the Wadi-Halfa gauge the level at Aswan on 31st of December should, had there been no holding up at the reservoir, have been about the same as in 1900 or 70 centimetres below the normal.

Summing up, the summer level was poor and corresponded closely with that of 1899, the lowest year on record with the exception of 1900. The rise commenced somewhat late but was at first satisfactory. From the 1st of July the rise became extremely slow, and record low-levels obtained up to the end of August. After this the levels began to improve. Although the mean flood levels were no better than those of the record low years of 1877 and 1899 the flood must be regarded as more favorable for basin irrigation than that of either of those years owing to the more advanced date at which the maximum level was reached.

The following statement shows the average of the daily gauge readings at the head of the Ibrahimieh Canal during the summer months of 1902 and in typical years.

At Asyut.

YEAR.	AVERAGE GAUGE-READINGS AT ASYUT DURING				Nature of Summer Levels.
	April.	May.	June.	July.	
1899	46·50	45·91	45·47	46·52	High.
1885	45·52	45·13	44·87	47·25	Fair.
1901	45·03	45·15	45·42	46·69	Low.
1889	44·99	44·75	44·57	45·60	Very Low.
1892	45·24	44·77	44·58	45·55	do.
1900	44·89	44·88	45·17	46·19	do.
1902	46·24	46·26	46·15	46·46	Regulation first made on Asyut Barrage.

Owing to regulation on the Assiut Barrage the levels during May and June were higher than those for any previous year.

In the interests of navigation on the Ibrahimieh canal, the sill of whose new head has been built one metre higher than the previous true-bed level, regulation on the Barrage commenced on the 3rd of February.

The following were the various instructions issued for conducting regulation:—

On the 14th of March to let the level up-stream of the Barrage fall to 46.50 and maintain it at that.

On the 13th of June to reduce the level up-stream of the Barrage to 46.20 and maintain it at that level till the river began to rise.

On the 16th of July to keep the down-stream level constant, and allow the up-stream level to rise to 46.40 and after that level had been reached to maintain a constant difference of 15 centimetres between the up-stream and down-stream levels.

The above instructions were followed pretty closely. The up-stream level on the 3rd of February was 46.46.

By the 24th of March it had reached 46.50, and remained at that level up to the 10th June. On the 19th of June it had fallen to 46.20, and continued at that level to the end of the month. The minimum up-stream level reached was 46.16 on the 27th of June. This level allowed a depth of 1.41 metres on the up-stream lock-sill.

The river began to rise from the 1st of July and on the 15th of July the levels up-stream and down-stream were 46.28 and 46.17 respectively. From the 16th of July the difference between the up-stream and down-stream levels of 15 centimetres was maintained, as closely as a rising river admitted of, till flood regulation started.

On the 10th of August, seeing the very low level of the river, it was determined in the interests of flood irrigation to raise the level above the Barrage. Accordingly on that date a commencement was made with lowering the bottom gates. By the 16th of August, all gates both top and bottom were closed. A head of 1.50 metres was thus induced on the Barrage. The maximum level attained up-stream of the Barrage was 51.90 on the 19th of September on which date there was a head of 0.97. On the 27th of October regulation ceased and the Barrage was fully open on the 29th of October. The average maximum flood-level at Asyut is 52.17 so the timely measure of regulating on the Barrage afforded a very fair flood supply in the Ibrahimieh canal, and converted what would have been a disastrous year for Middle Egypt into one of very fair flood irrigation. The diagram on

Plan II shows the effect of this flood regulation on the gauge at the head of the Ibrahimieh canal.

Owing to the completion of the Barrage the Asyut gauge is no longer available for purposes of comparison so it is necessary to refer to some other gauge not affected by that work. The Sohag gauge is as good as any. The following statement gives the average of the daily gauge readings at Sohag for past three years:—

YEAR.	AVERAGE GAUGE READINGS AT SOHAG DURING				REMARKS.
	April.	May.	June.	July.	
1900... ..	53.53	53.43	53.61	54.78	Very Low.
1901... ..	53.99	53.73	53.83	55.40	Low.
1902... ..	54.02	53.86	53.83	55.03	Low.

The maximum and minimum levels at Sohag for the years included in the above table were as follows:—

YEAR.	Maximum Level.	Minimum Level.	Difference.	REMARKS.
			in.	
1900... ..	60.48	53.38	7.10	
1901... ..	60.75	53.62	7.13	
1902... ..	59.72	53.78	5.94	

Gauge at
first Cataract.

The following statement gives the highest and lowest levels recorded above and below the 1st cataract for the past six years:—

YEAR.	MINIMUM GAUGE READINGS.			MAXIMUM GAUGE READINGS.		
	Phila.	Aswan.	Difference.	Phila.	Aswan.	Difference.
			in.			in.
1897... ..	90.56	85.62	4.94	97.95	92.80	5.15
1898... ..	89.74	84.74	5.00	99.05	93.63	5.42
1899... ..	90.70	85.15	5.55	97.60	91.67	5.93
1900... ..	91.20	84.07	7.13	98.54	92.91	5.63
1901... ..	90.90	84.54	6.36	99.07	92.82	6.25
1902... ..	91.10	84.43	6.67	97.70	91.72	5.98

The levels on the Philae gauge were affected by the Reservoir. The entire flood discharge was passed through the Reservoir sluices. Comparing the maximum levels of 1899 and 1902 the afflux induced by the dam would appear to be between 60 and 70 centimetres.

The river gauges south of Aswan recorded during the year were on the White Nile, Gondokoro, Nasser (on the Sobat), Fashoda, Duem; on the Blue Nile, Roseires, Sennaar, Wad-Medani.

The Gondokoro gauge was washed away on the 12th of November and replaced at a different site. Records for the Nasser gauge were only received up to May. Records for the Fashoda gauge were received from February to March. The Blue Nile gauges were steadily recorded, as were the Khartoum, Berber and Halfa gauges. The Athara gauge was recorded during the flood from 2nd of July to 20th November. The following statement gives the maximum and minimum levels observed on the gauges in the above list for which unbroken records were kept during the year:—

NAME OF GAUGE.	1897		1898		1899		1900		1901		1902	
	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.
Gondokoro, ...	—	—	—	—	—	—	—	—	—	—	0.12	2.00
Duem... ..	—	—	—	—	—	—	—	—	0.27	4.30	0.48	3.72
Roseires	—	—	—	—	—	—	—	—	1.29	8.12	1.62	10.54
Sennaar	—	—	—	—	—	—	—	—	—	—	2.04	7.04
Wad-Medani ...	—	—	—	—	—	—	—	—	—	—	0.33	10.70
Khartoum... ..	—	—	—	—	0.46	5.59	0.26	6.49	0.08	6.10	0.10	5.48
Athara,	—	—	—	—	—	—	—	—	—	5.60	0.20	4.80
Berber,	—	—	—	—	—	—	0.41	7.67	0.63	7.87	0.61	7.05
Halfa	1.86	8.00	1.09	8.72	1.46	6.92	0.90	8.06	1.04	8.08	1.13	7.15

The average maximum gauge reading on the Halfa gauge for the past 12 years is 8.28, so the maximum level attained on that gauge during the flood of 1902 was 1.13 metres below normal.

SECTION II. — SUMMER IRRIGATION.

The volumes entering and utilized in the Ibrahimieh Canal during the summer months of the last eight years, and the very low years of

1889 and 1892 are given below in cubic metres per sec., together with the dates of complete closure of the Deirut escape :—

YEAR.	APRIL.		MAY.		JUNE.		Date of complete closure of the Deirut Escape.
	Discharge at head.	Discharge utilized.	Discharge at head.	Discharge utilized.	Discharge at head.	Discharge utilized.	
1889	37·1	37·1	32·5	32·5	26·4	26·4	15th February.
1892	48·4	48·4	36·1	36·1	29·5	29·5	25th March.
1895	121·2	84·2	92·1	87·7	81·7	81·7	12th May.
1896	100·2	86·2	75·7	75·7	64·6	64·6	16th April.
1897	115·4	81·4	100·9	81·4	82·8	82·8	17th May.
1898	62·7	62·7	59·5	59·5	47·3	47·3	29th March.
1899	145·1	96·5	123·5	118·4	83·0	83·0	1st June.
1900	46·9	46·9	41·9	41·9	49·4	46·1	14th February. Re-opened 20th May.
1901	48·4	48·4	46·6	41·8	64·6	64·6	Re-closed 10th June. 16th February. 16th to 10th January. 20th Jan. to 2nd Feb. 6th Feb. to 24th Feb. 6th March to 25th Mar. 27th June to 5th July. 10th July to 10th Oct.
1902	82·8	54·6	101·5	64·7	106·7	66·2	

The average discharges recorded in this table are based on discharges observed on the 1st and 15th of each month, each discharge given being the average deduced from three observed discharges. The frequent openings and closures of Deirut Escape were due to regulation on Asyut Barrage which gave bigger discharges in the canal than required at the beginning of the year, and later on necessitated regulation of supply between Middle Egypt and Lower Egypt. The arrangement made for this regulation was that the levels in the Middle Egypt Canals taking off at Deirut should be maintained 10 centimetres higher than 1900 so long as the Aswan gauge continued to fall at the same rate as in 1900. Under this agreement the escape remained open from 25th of March to 27th of June and again from 5th to the 15th of July. Similar regulation was not necessary in 1901 as, owing to the unsatisfactory condition of its head in that year, the Ibrahimieh drew a poor supply during the summer.

The Fayoum supply was regulated by maintaining the level at the head of the Bahr Yusef 10 centimetres higher than in 1900 under the agreement with Lower Egypt.

The minimum discharge of the Bahr Yusef below Lahun recorded during the year was 578,749 M³ per day. So this must be added 220,579 M³ on account of the Hassan Wassif Canal, the new supplementary feeder for the Fayoum taking out above Lahun, which makes the minimum discharge entering the Fayoum 799,328 M³ per day. The mean of five previous low years since 1891 is 765,948 M³ per day.

Fayoum
Supply.

The mean for four high years during the same period was 1,739,656M³ per day.

The mean discharge of the Bahr Yusef below Lahun from the middle of April to the middle of July was 1,300,000 M³ per day. The mean discharge of the Hassan Wassif Canal for the same period was 300,000 M³. Hence the mean summer discharge entering the Fayoum may be taken as 1,600,000 M³ per day. The area under summer crop in the Fayoum is given as 17,142 feddans from which a duty of 34 M³ per feddan per day is deduced. From the middle of May to the end of June the mean discharge was 1,120,000 M³ which gives a duty of 23·8 M³ per feddan per day. The general opinion during the summer was that the crop would show a large increase on that of 1901, but according to returns it was smaller by 6,812 feddans. I have not much faith in the accuracy of the said returns.

Rotations were commenced on the dates shown in the following Rotations statement : —

PROVINCE.	CANAL.	Date of commencing Rotations.
Asyut	Sahiliyah	1st April.
Asyut	Deirutiyah	1st April.
Minia	Ibrahimiya... ..	20th March.
Beni-Suef	Ibrahimiya... ..	20th March.
Fayoum	Bahr Yusef and branches...	13th April.

There were three classes of rotations of increasing severity as shown in the following table : —

CLASS.	PERIOD OF ENFORCEMENT.	FREQUENCY OF WATERINGS.			
		Minia.	Beni Suef.	ASYUT.	
				Sahiliyah.	Deirutiyah.
I.	1st April to 16th April.	—	—	Once in 16 days	—
"	1st of April to 19th April.	—	—	—	Once in 19 days
"	20th March to 27th April.	Once in 19 days	—	—	—
"	20th March to 24th May.	—	Once in 22 days	—	—
II.	17th April to 5th May.	—	—	Once in 19 days	—
"	20th April to 11th May.	—	—	—	Once in 21 days
"	28th April to 19th May...	Once in 22 days	—	—	—
"	25th May to 17th June.	—	Once in 24 days	—	—
III.	6th May to 24th July...	—	—	Once in 20 days	—
"	12th May to 25th July.	—	—	—	Once in 26 days
"	20th May to 19th August	Once in 24 days	—	—	—
"	18th June to 9th August	—	Once in 26 days	—	—

Rotations commenced in the Fayoum on 13th of April and ended on 30th July. The arrangement described in last year's report was adhered to and worked satisfactorily.

The low flood supply in the Yusufi necessitated partial rotations in the Fayoum during the second half of September.

Rotations were enforced on the Bahr Yusuf lifting machines from 1st of June to 25th of July. The nature of the rotation was 6 days working and 12 days stoppage.

The areas under cotton irrigated by the Ibrahimieh Canal and its branches in the past six years are as follows:—

In 1897	...	...	...	...	...	...	...	90,696 Feddans
In 1898	...	...	...	...	...	...	...	100,005 "
In 1899	...	...	...	...	...	...	...	90,887 "
In 1900	...	...	...	...	...	...	...	92,842 "
In 1901	...	...	...	...	...	...	...	105,750 "
In 1902	...	...	...	...	...	...	...	95,356 "

The following statement kindly furnished by Mr. Wakeham, Agent of Messrs. Carver Bros. in Upper Egypt, shows the out-turn of the ginning factories in the different provinces during the past 10 seasons.

SEASON.	Minia.	Bent Saeif.	Fayoum	Total.	Average price per Kantar
					P. T.
1893-1894	30,000	85,000	75,000	190,000	210
1894-1895	50,000	120,000	90,000	260,000	165
1895-1896	82,000	150,000	130,000	362,000	205
1896-1897	107,000	154,000	138,000	399,000	205
1897-1898	125,000	178,000	163,000	466,000	162
1898-1899	74,000	143,000	137,000	354,000	156
1899-1900	105,000	139,000	170,000	414,000	205
1900-1901	104,000	131,000	130,000	365,000	275
1901-1902	128,000	174,000	130,000	432,000	205
1902-1903	162,000	165,000	145,000	472,000	275

The out-turn was therefore a record one. The out-turn works out to 4.97 kantars per feddan against 3.92 kantars and 4.1 kantars in the two previous seasons. As the out-turn was commonly reported to be below rather than above the average the area reported as being under cotton is probably a good deal too small. I have remarked above on the small Sefi area reported from the Fayoum where the reports of the Chief-Engineer led one to expect a considerable increase in area. An actual check of the figures submitted by Omdes in the case of a few villages would be interesting.

The cotton
crop.

The following statement gives the area of feddans of cotton irrigated by the Ibrahimieh Canal in the different Provinces during the past five years : —

YEAR.	Assuit.	Minia.	Beni Suef.	Fayoum.	TOTAL.
1898	2,635	19,580	26,253	57,537	100,005
1899	1,874	20,576	22,277	46,160	90,887
1900	2,753	27,912	26,086	36,991	92,842
1901	3,361	26,599	28,177	47,643	105,780
1902	1,824	26,085	27,103	40,344	95,356

The figures for Minia and Beni-Suef include an area of 7,224 feddans irrigated from the Bahr Yusef. Areas irrigated from the Bahr Yusef are included in the totals for previous years, correctly so I think, as the Bahr Yusef is as much a branch of the Ibrahimieh as the Deirutiyah or Sahiliyah Canals; comparing out-turns with average, the area given for the Fayoum for 1902 is either too small or that given for 1901 is too big. Besides the areas included in the above table there were 380 feddans of cotton irrigated in hoshabs above Deirut and 4,237 feddans irrigated from wells in the Beni Suef basins.

The following statement gives the quantities of cane crushed in the chief factories in Upper Egypt, and the out-turn of No. 1 Sugar, during the past five seasons:—

Sugar Cane.

SEASONS.	DOKKI SUGAR FACTORIES.			DEIRA SUGAR FACTORY.			SOCIETE DESCHALE DE SUCRERIE DE LA HAUTE-EGYPTE.			EGYPTIAN SUGAR AND LARD COMPANY.		
	Cane crushed.	Outturn No. 1 Sugar.	Percentage.	Cane crushed.	Outturn No. 1 Sugar.	Percentage.	Cane crushed.	Outturn No. 1 Sugar.	Percentage.	Cane crushed.	Outturn No. 1 Sugar.	Percentage.
	Kantries.	Kantries.		Kantries.	Kantries.		Kantries.	Kantries.		Kantries.	Kantries.	
1898-1899	13,880,614	1,250,395	9.0	179,922	13,595	9.1	8,228,370	694,602	8.4	516,550	19,339	3.8
1899-1900	14,619,564	1,369,968	9.4	169,027	12,000	9.2	8,578,871	573,169	6.6	591,506	40,606	6.7
1900-1901	11,850,190	1,101,471	9.3	221,160	16,468	9.4	6,908,712	682,387	9.8	620,500	81,810	13.0
1901-1902	12,442,462	1,246,845	10.0	116,465	10,230	8.7	7,608,349	612,815	8.1	—	—	—
1902-1903	11,116,491	1,008,165	9.0	106,901	16,800	15.6	8,004,797	490,385	6.1	—	—	—

The total number of kaptars crushed and the total out-turn of No. 1 Sugar for each of the five years included in the statement are as follows:—

SEASON.	Cane Crushed.	Out-turn of No. 1 Sugar.
1898-1899	20,957,441	1,950,750
1899-1900	21,969,136	2,080,637
1900-1901	20,134,223	1,975,337
1901-1902	20,506,465	1,928,886
1902-1903	19,719,209	1,870,582

The following statement gives the areas under sugar cane irrigated from the Ibrahimieh Canal in the different provinces during the last five years, and the area grown south of Asyut irrigated by river pumps and wells:—

YEAR.	Asyut.	Miula.	Beni-Suef.	Fayum.	Total.	South of Asyut.	Grand Total.
1898 ...	9,883	35,232	5,383	854	51,352	—	—
1899 ...	9,473	33,829	7,082	677	51,061	—	—
1900 ...	8,052	22,139	5,670	458	36,319	17,440	53,759
1901 ...	12,780	28,413	6,282	618	48,093	14,522	62,615
1902 ...	10,519	28,904	5,725	799	45,947	15,091	62,038

The aggregate area under sugar and cotton north of Asyut shows a decrease as compared with 1901 of 14,540 feddans, but the record out-turn of cotton makes this decrease in area very doubtful.

Sorghum or
Summer
Durah.

The following statement gives the areas of Summer durah or "Qedi" grown in the basins of the different provinces during the last four years:—

YEAR.	AREAS IN FEDDANS IN THE DIFFERENT PROVINCES.							Total Area.
	Assuan.	Kenna.	Ghem.	Asyut South.	Asyut North.	Miula.	Beni-Suef.	
1899...	3,195	23,334	29,984	10,150	8,572	5,495	7,072	87,346
1900...	2,972	24,258	39,261	12,389	7,701	3,890	6,076	96,547
1901...	2,482	21,526	41,433	10,334	7,850	4,734	8,734	97,093
1902...	3,381	19,510	38,372	12,555	9,232	5,072	5,384	93,546

In Beni Suef Province an area 4,237 feddans of cotton was irrigated from wells in basins which accounts for the shrinkage in area under Qedi in that Province.

The area of Nabari durah sown in the southern provinces is estimated at 164,692 feddans. The average area for the three years 1899-1901 was 144,205 feddans. In the very low flood of 1899 the area was 155,000 feddans. The yield of the Nabari crop was good and the winter crop is a promising one.

The total area of summer crops irrigated by the Ibrahimieh canal, according to figures furnished by the chief Engineers, is shown in the following statement:—

PROVINCE.	Cotton.	Sugar Cane.	Sefi Durah.	Other Crops.	Total.
Asyut	1,824	10,162	15,172	502	27,660
Minia	21,398	28,836	7,265	825	61,324
Beni Suef	21,566	5,725	283	1,717	29,291
Fayoum	40,344	799	—	5,999	47,142
Totals... ..	88,132	45,522	22,720	9,043	165,417
Add for area irrigated from Bahr Yusef and in hoshas south of Deirut					7,604
Grand Total... ..					173,021

The mean discharge for the summer months April to June utilized in the Ibrahimieh Canal may be taken as 5,399,445 cubic metres per day. On the area of summer crops given above this discharge gives a duty of 31.2 cubic metres per feddan per day. Judging from the out-turn of crops and the severity of the rotations required it is probable that the area given as under Sefi crop is too small and the above duty consequently too low.

The mean and minimum discharges recorded during the year in the Ibrahimieh Canal and Bahr Yusef are as follows:—

USAL.	Site.	Mean discharge April to June.	Lowest recorded discharge.
		C.M.	C.M.
Ibrahimieh (1)	Above Deirut ...	5,399,445	1,249,152
" (2)	Below Deirut... ..	2,867,369	2,674,944
" (3)	" Maghagha ...	702,309	604,800
Bahr Yusef & Hassan Wassif.	" Lahun ...	{ 1,600,000 } 1,120,000	800,000
Ibrahimieh	Minia Province (2)(3)	2,165,060	2,070,144

Taking the areas in the different provinces we obtain the duty of water in each group as follows:—

PROVINCE.	Total Area in '000s.	Duty on mean discharge.	Duty on minimum recorded discharge.
Assut, Minia, Beni Suef and Fayoum...	173·021	31·2	21·6
Minia & Beni Suef together irrigated from Ibrahimieh canal only...	90·615	31·6	20·5
Beni Suef alone irrigated from Ibrahimieh.	29·291	23·9	20·6
Fayoum. ...	47·142	33·9	16·4
Minia alone irrigated from Ibrahimieh. ...	61·324	23·8	33·7
		35·3	

In the case of the Fayoum the larger discharge is the mean discharge from the middle of April to the middle of July, and the smaller the mean discharge from the 15th of May to the end of June during which period the supply was short. According to the above figures Beni Suef did not fare nearly so well as Minia, but the absence of complaint from the former province lead some to suspect that the explanation of the disparity in the supplies is probably due to incorrect returns of areas.

SECTION III.—FLOOD IRRIGATION.

General
character of
the flood.

The diagram on Plan I shows the Aswan flood gauges for 1902, 1877, 1888, 1899, the four years of very low floods for which records exist. The cycle of eleven years has been broken, the last very low flood having occurred in 1899.

The following statement compares the maximum and mean flood gauges at Aswan for the four years shown on the diagram:—

Aswan Flood-Gauges.	1877		1888		1899		1902	
	Gauge-Reading.	Date.	Gauge-Reading.	Date.	Gauge-Reading.	Date.	Gauge-Reading.	Date.
	F. H.		F. H.		F. H.		F. H.	
Maximum reading ..	13 10	4th Sept.	11 16	23rd Aug.	13 22	1th Sept.	11 0	17th Sept.
Mean of 40 days ending the 24th Sept. ...	12 23	—	13 22	—	13 0	—	12 2 1/2	—
Mean of irrigation south of Sohag, 11th August to 1th Oct. ...	12 19	—	13 15	—	12 17	—	12 8	—
Mean for irrigation north of Sohag, 10th August to 20th Oct.,	12 9	—	12 23	—	12 1	—	12 2 1/2	—

The mean flood levels were slightly inferior to those of any of the three very low floods selected for comparison.

The favorable feature of an otherwise very bad flood was the date on which the maximum level was reached, viz. the 17th of September, and the gradual fall, which means that the river level rose with the levels in the basins, an early maximum level followed by a steady fall, as in 1899, means that the river falls just when the lower portion of the basins become full and thus the period during which the basin canals work effectively is diminished.

Water began to enter the Aswan isolated Basins on August the 23rd and the maximum levels attainable were reached by September the 23rd. Nothing can be done to help these basins in low years in the shape of temporary works, as in the case of the basins chains further north. Filling Basins.

The estimated sharaki area is 1,315 feddans less than in 1899.

Water began to enter the basins of the Ramadi system between the 16th and 24th of August, and the maximum levels attainable were reached between the 19th of September and the 19th of October.

Kilh Regulator, Ramadi Canal, was closed from 19th of September to 20th of October for the benefit of the Ramadi and Edfu Basins.

Maamarya Regulator was closed from the 11th to the 20th of September and again from the 2nd to 3rd October for the benefit of Hods Bassalya, Sibaya and Namasa. Qarya Regulator was closed from the 1st to the 11th of September, and again from the 20th of September to the 10th of October for the benefit of the Esna Basins.

The Umm-Adas Canal drew little or no water. Hod Asfûn and Wadi-El-Ginn were divided by a longitudinal bank. The higher eastern portion was flooded from the Ramadi Canal through Hod Musallas, the lower western portion from Hod Esna north.

Water entered the basins of the Asfûn system between the 16th and 23rd of August. The maximum levels attainable were reached between September the 26th and November the 8th. The regulator at kilometre 25 of Asfûn Canal was closed from 28th of September to the 16th of October. The maximum level attained above it was 78·27.

Water entered the basins of the Fadiliyah system between the 19th of August and the 20th of November.

Maximum levels were reached between the 14th of September and the 29th of November. The most was made of the water available by enclosing the higher portions of the several hods by temporary banks.

Water entered the basins of the Sahil Farshut system between the 24th of August and the 19th of October. Maximum levels were reached

between the 15th of September and 31st of October. The regulators in the Samhud Salibah were closed throughout the flood.

Water entered the basins of the Killabiyah system between the 17th and 20th of August. Maximum levels were reached between the 30th of September and the 12th of October. The maximum level reached at the head of the Killabiyah Canal was 79.90 which is 1.45 below the T.R. Level of Hod Hilla Der. The latter hod consequently only got a supply in its sayalus for durah, and had a sharaki area of 2,030 feddans.

Water entered the basins of the Bayyadiyah system between the 18th and 25th of August. Maximum levels were reached between the 28th of September and 20th of October. The Kluzan Regulator at kilometre 21 of the Bayyadiyah Canal was closed from the 21st to the 28th of September to fill Hods Ashi.

The Shanhuriyah Canal began to run on the 12th of August. The basins reached their maximum levels between the 16th and 27th of October. The Shanhuriyah Regulator at kilometre 20 of the canal was closed from the 23rd to the 30th of September for the benefit of the Qift Basins.

The Ghilasi and Samata canals began to work on the 17th and 20th of August respectively. The Hamad Escape drew water from 16th to 20th of August, and the Hisha Escape from 15th of August to 28th of September. The basins attained their maximum levels between the 14th of September and 9th of November. The Abu Manma Regulator in Salibah Hod Dishma was partially closed from the 16th to 30th of September and tightly closed from the 1st to 6th of October. The level in Hod Dishma was thus raised to within 0.68 of T.R.L.

In Girga Directorate the main canals were opened between the 11th and 20th of August. The following escapes drew water from the river:—

Sohag West Basin escape S. Sohag system from 17th Aug. to 20th Aug.		
Abu Zig escape North Sohag	..	21st Aug. to 22nd Aug.
Moria .. ..	..	21st Aug. to 23rd Aug.
Shuth .. ..	..	23rd Aug. to 27th Aug.
Selim .. ..	..	16th Aug. to 20th Aug.
Qaw Khizindariya	..	18th Aug. to 4th Sept.
Tawabiyah Abnub	..	3rd Sept. to 11th Sept.

Levels were too low to admit of any other escapes being used as feeders.

Water entered the Khiyam Basins between August the 22nd and September the 1st. Maximum levels in the basins were reached between September the 13th and October the 25th. The Tarif canal was closed on the 27th and the Hawis Canal on the 28th of October. Awlad Yehya Canal did not work at all during the flood. The high portions of Hod Khiyam, Hammam West, Mazata, and Awlad Yehya were surrounded by Hosha Banks and flooded during Sarf.

In the Akhmim system the Issawiyah and the Lahaywa canals began to work on the 15th and 20th August respectively. Maximum levels were reached between the 18th of September and 14th of October. At the end of September the Lahaywa Canal and Sayyala Akhmim West were saddled, and two small branches made from the latter channel above the sudd, so as to command the higher portions of Hod Akhmim. The results of this operation were completely successful.

Water from the Gebel Haridi Canal reached the Khizindariyah system on the 21st of August. The Khizindariyah Canal began to work on the 11th of August. Water was held up on the Tonna Regulator from the 28th of August to the 14th of October, and on the Haridi Regulator from 7th to 13th of October. Hassan Darwish Regulator was completely closed from the 20th of September to 6th of October, and Shamiyah Regulator from 20th to the 26th of September. Maximum levels were attained between September the 25th and October the 26th. Hods Badari East and Sahil reached a maximum level 40 centimetres below T.R.L. The other hods in the system either reached T.R.L. or within 20 centimetres of it.

Water from the Mahgar Matmar Canal reached the Abnuh system on the 17th of August, but, owing to the heavy regulation on Hassan Darwish Regulator, only began to yield a good supply from 6th October. The Maanua Canal was opened on the 12th and the Sunt Canal on the 14th of August. The former benefitted considerably from the regulation on Asyut Barrage. The canals taking off the river north of the Barrage did not work during the flood. Maximum levels were reached between the 1st of October and the 12th of November. The area left unirrigated was insignificant.

In the South Sohag system the Rashwaniyah, Zarzuriyah, Kasra and Girgawiyah canals were opened between the 13th and 19th of August, and water passed down to the tail basins. Hod Khalafiyah and Hosha Birla were flooded by repairing the left bank of the Rashwaniyah canal in Hod Bardis, closing heads of sayyals and borrow pits taking off it, and passing the Rashwaniyah water in sayyala Uthmaniyah. A large area of shuraki was avoided by this operation. Hoshet Isayrat was

flooded with water coming from the Rashwaniyah during sarf by placing sadds in the latter canal and opening Hemedi syphon and escape, as well as Sheikh Yusef and Birba Regulators. Hosha Banks were made round high tracts in the several basins where necessary maximum levels were attained between the 24th of September and 25th of October. The Kasra and Zarzuriyah canals were closed on the 28th of October. The Rashwaniyah and Girgawiyah canals were kept open for Nabari. The sharaki area in the system is only estimated at 1,458 feddans which, if the estimate is fairly correct, is very satisfactory seeing that the maximum levels attained in the basins fell short of T.R. levels by amounts varying from 30 centimetres to 1 m. 50.

In the North of Sohag system the Heweti, Sohagiyah, Tahtawiyah, and Shattura canals were opened between the 14th and 17th of August. The Ablag canal was opened on the 5th of September but rendered little service. The Abu Zig, Selim, Moteah and Shurb escapes all drew water for a few days. The Salibah Samarra Regulator, Girgawiyah canal, was closed from the 2nd September till the commencement of Sarf. On the 20th of September regulation was commenced on the Nag Tamman Regulator, Beni Hilal Head, and Widiyah culvert for the benefit of the basins south of the Nag Tamman Salibah. This regulation continued till the 7th of October. On the 27th of August the Gebel Asyut Bridge was closed. On the 1st of September the escapes of Umm Durah East and West Basins were closed. On September the 15th when the level in Hod Zinnar was 53.33, Gebel Asyut Bridge was partially opened to pass water on to the North Asyut Basins. On the 21st of September the regulators in Salibah Beni Smia were partially closed to keep Hod Zinnar slightly below T. R. level. Regulation on the New Talihat Regulator began on the 23rd of September. The unfortunate partial failure of this regulator is alluded to further on. Luckily the basins dependent on it, aggregating 50,200 feddans, were all filled before the accident. The maximum level attained up-stream of the regulator was 58.20. On the 1st of October the regulators in Salibah Beni Smia were closed, and the sarf of Hod Zinnar on to the northern Asyut Basins commenced. On the Tahtawiyah Canal, regulation was made on the Banga, Tahta and Banaha Regulators on the 2nd, 17th and 23rd of September respectively, giving a maximum level up-stream of the first of 58.06, up-stream of the second of 58.08, and up-stream of the third of 58.64. On the Shattura Canal the Sedfa Regulator was closed on the 4th of September, and the Tema Railway Bridge on the 29th of September so as to turn all the Shatturah supply into Hod Duer East.

Hoshah banks were made round the higher portions of the several hods. Hod Zinnar reached T.R.L. The maximum levels attained in the other hods of the system fell short of T.R.L. by amounts varying from 5 centimetres to 94 centimetres. The estimated sharaki area is 1,350 feddans. Appendix Z gives the maximum levels attained during the past flood in each basin of the southern systems down to Asyut together with the T. R. levels and the estimated sharaki areas. The result of the Sharaki Commission now at work may modify the figures for sharaki given in the statement, and the estimates formed by the local irrigation officers may turn out to be slightly too sanguine.

In the 4th Circle owing to the short supply from the Solagiyah Canal Gebel Asyut Bridge was closed completely on the 27th of August, and tank-filling through it only commenced on the 15th of September. On the 20th of September the bridge was fully open. Surf of Hod Zinnar on to the Asyut Delgawi chain of basins commenced 1st of October. All salibah bridges in the chain had been closed on on the 27th of August to store water.

The basins on the east of the Ibrahimieh, south of Deirut, began to receive water when regulation was started on the Asyut Barrage. There was a considerable area of sharaki in the three southern hods. The proposed Walidiyah syphon should obviate sharaki in these hods in the future. It was found necessary to make several hoshas in Hod Manfalut south, by the aid of which practically the entire hod was irrigated.

In Minia Province Hods Tamashawi, Quran and Tahawi had been converted into perennial tracts before the flood. Abu-Baqara and Etsa canals began to work on the 19th and 25th of August respectively but drew very little water. Hods Deri, Mangatin and Minhal were filled from the new Sabakhah Canal which was carried as far as Salibah Tahawi before the flood; and by the discharge coming down the Mohit Main Drain, the northern Minia basins were filled from the Yusufi during surf. A level of 46·00 was maintained at the head of the Yusufi for the irrigation of the West Yusufi basin chains from the 16th of August. The level above Nazlet El Abid Regulator was 40·50 and above Suqula Regulator 33 to 33·50. The average level below Mazurah was 28·30 which gave a level of 26·00 at Lahun. The West Yusufi basins filled well. Branches through the sand-hills on their western boundary and in some of the salibahs gave some trouble.

A level of 46·00 at the head of the Yusufi only suffices to fill the basins west of Yusufi and give the minimum flood supply in the Fayoum, leaving no red water available for Hods Kushesha and Riqqa, which hods have suffered considerably during the past few years of low floods.

A salibah bank on the Tansa line is much required to give the southern portion of Koshesha a chance of obtaining some red water, but as the hod will probably be converted into a sefi tract in 1905 it is too late to do anything now. It was considered advisable to feed Hod Delgawi through its escape at Deirut as otherwise its sarf would have been very late.

In Beni Suef the Nile canals began to work on the following dates :— Sultani canal on the 21st of August ; Babashin canal on the 26th of August ; Nina canal on the 27th of August ; Magnum canal on the 28th of August ; Koshesha escape on the 13th of August. The supplies drawn in were very small. The following statement shows the dates on which the several systems reached their T.R. levels:—

NAME OF SYSTEM.	Dates between which T.R. levels were reached.	REMARKS.
Asyut Delgawi	1st to 10th Oct.	Hoshah Delgawi reached T.R.L. on 16th Oct. from sarf of Hod Qosiyah.
West Yusufi Asyut ...	10th to 13th Oct.	Hod Beni Khalid can be filled without regulation on its escapes.
East Ibrahimieh Asyut to Deyrut Sabakhah..	5th to 14th Oct.	Hods Walidiyah and Beni Hussen East and West did not reach T.R.L. Hods Tanashawi, Quran and Tahawi converted into perennial tracts before the flood.
Etsa... ..	16th to 24th Oct.	Fed from branches of Sabakhah canal in Hod Tahawi, and from branches of Ibrahimieh canal through the West Mohit drain discharging into S. E. corner of Hod Déri.
Abu Baqara	22nd to 28th Oct.	Filled by sarf of Etsa system and by a cut in Yusufi tarrad in S. W. corner of Hod Bardanaha.
West Yusufi South System, Minia Province	During first half of Oct.	Delayed by breach in Sushah Salibah.
West Yusufi North System, Minia Province.	1st half of Oct.	Filled without trouble.
Beni Suef Basins	28th Oct. to 26th Nov.	Little or no water reached these basins till the sarf water in the Yusufi arrived on 21st October.

The following cuts were made to pass water quickly through the Asyut Delgawi chain.

In Beni Kalba Salibah on the 4th of October.

In Beni Rafi „ „ evening of 4th October.

In Maharaq „ „ „ „ 5th October.

Delgawi escape was partially opened on the 9th of October the level in Hod Delgawi being then 45.58 or 22 centimetres below T.R.L. Delgawi reached T.R.L. on the 10th of October.

Hoshah Tunah received water from the Yusufi through a new feeder and was brought up to T.R.L. from Hod Delgawi through Hataba Bridge on 12th of October. Hod Tunah was also fed from the Yusufi and brought to T.R.L. on the 13th of October from Hoshah Tunah. In Beni Khalid Hod a constant level of 42.00 at its northern end was maintained. This hod can now be filled without regulation on its escapes. The Chief Engineer of Asyut made the mistake of regulating on these escapes on the 13th of October, thereby unduly raising the level of the Yusufi and causing a breach in the tarrad of the Hod. The escapes were opened again on the 15th of October.

The surf wave in the Yusufi reached Beni Suef Province on the 21st of October. Until then the Beni Suef Basins had received hardly any water. A level of 31.00 was maintained above Mazurah Regulator from 8th of October. On the arrival of the surf wave the Regulator was opened; as the wave subsided regulation was recommenced and a level of 31.00 to 31.15 maintained up stream of the Regulator till the 31st of October. The stone sadds in Mazurah Salibah were closed with earth and re-opened, when Hod Sultani was full, to irrigate the west sahels of the Yusufi. To assist the Mazurah Bridge in the tarrad of Hod Sultani a cut was made. As all the discharge entering Hod Sultani had to pass over the syphon on the new drainage escape the hod took a long time filling. Thanks to Mazurah Regulator there was no Sharaki in Hod Sultani as in 1899. Hods Nina Nuera and Babashin were filled in succession with the water passing forward from Hod Sultani. Hod Babashin reached T.R.L. on the 10th of November, when its salibah bridges were opened on the Hod Koshesha; a cut was also made in the salibah to expedite matters. Koshesha Escape had been closed on the 10th of October, as were also the Koshesha Salibah Bridges and Komi Regulator. On the 24th of October the salibah bridges were partially opened to feed Hod Riqqa. Komi Bridge was partially opened on the 30th of October. On the 7th of November Koshesha Salibah Bridges were again closed and Koshesha reached T.R.L. on the 12th of November. On the 13th of November the

salibah bridges were opened on to Hod Riqqa. Owing to the heavy supply passed forward to Gizeh through Komi Regulator Hod Riqqa did not reach T.R.L. till the 26th November. On the 28th of November the opening of Koshesha Escape commenced and the salibah bridges were closed as no more water was required in Gizeh. Atwah escape was opened for the sarf of Hod Riqqa on the same date.

Regulation
between
the 4th and
3rd Circles.

The orders issued by Sir Hambury Brown, Acting Under Secretary of State, for regulation on Komi in 1902 were as follows :—

REGULATIONS FOR THE DISTRIBUTION OF WATER DURING FLOOD
BETWEEN THE 4TH AND 3RD CIRCLES.

4th Circle.—From the commencement of the flood Koshesha Escape, the bridges in Salibah Koshesha, and Komi Bridge, shall be left fully open and remain open so long as there is a flow from the river through Koshesha Escape into the basin.

3rd Circle.—The 3rd Circle will also keep Girzah Head open as long as there is a flow through it into the basin, and will keep the W. L. in Hod El Muarkab and Hod Tahma low by leaving their bridges on the north limits of the basins open so as to maintain a draw from the river into the basin as long as possible. As soon as the flow through Girzah Head is reversed and the water begins to flow back into the river the Girzah Head will be tightly closed.

4th Circle.—When the flow into Koshesha basin from the river by way of Koshesha Escape ceases, that escape will be closed, as well as Komi Bridge, and the bridges in Salibah Koshesha will be regulated on so as to raise the W.L. in Hods Koshesha and Riqqa.

3rd Circle.—The Inspector of 3rd Circle will then re-open Girzah Head and draw into his basins as much water as the river level will allow, keeping the level of Markab and Tahma low as before.

3rd and 4th Circles. — If the river falls so low that the supply through Girzah Head becomes insufficient to keep the Nabari crop along the Railway alive, the Inspector of 3rd Circle will ask the Inspector General of Irrigation, Lower Egypt, to arrange for the opening of the Koshesha Salibah Bridges and Komi Bridge to such an extent that the water

It was found impossible to give the level of 24.77, which is the T.R. level below Komi, as early as the 7th of November. This level was asked for in order to bring the Gizeh Canal up to flood level to irrigate the hoshas and sahels along it. The Director of the Barrage assumed he could get the levels asked for and made his arrangements accordingly. Once the flooding of the hoshas and sahels commences it cannot well be stopped owing to the presence of durah which cannot be flooded more than a few days without suffering. A heavy supply was passed forward through Komi from the 30th of October. Had the flooding of the hoshas and sahels along the Gizeh Canal been postponed till Riqqa was nearly full no difficulty would have been experienced. This is a point to be born in mind for future guidance. In fact, as stated in the instructions of Sir Hanbury Brown, "Gizeh must wait for the completion of its basin filling till the operations of sarf have been begun and the 4th Circle is able to pass on sufficient water."

Regulation
at Deirut.

At the end of September high levels are required at Deirut for the benefit of the Deirutiyah and Sahiliyah canals.

A high level is also required about the 7th and 8th of October for flooding the Yusufi sahels between Deirut and Badraman. The amount of regulation on the Asyut Barrage began to be reduced from the 19th of September which caused the level at Deirut to fall. In order to obtain the supply required it was necessary to reduce the level in the Ibrahimieh below Deirut. The levels maintained below the Deirut Ibrahimieh Regulator were:—

From 21st to 25th September	45.20
From 26th September	44.56
From 27th September to 1st October ..	44.56 to 44.79
From 2nd October to 7th October	44.80
From 8th October to end of flood	45.40

This reduction of supply in the Ibrahimieh Canal below Deirut was severely criticized by a well known irrigation authority as an un-warranted procedure without precedent. As a matter of fact similar regulation of severe nature was made in the low years of 1888 and 1899. The Inspector General of the Daira Sanieh estates stated that the regulation did no injury in the Daira estates which form the bulk of the area on the Ibrahimieh Canal below Deirut.

Discharge
of Basins.

In the 5th Circle.—The following statement gives the dates of commencement and completion of sarf operations in the different systems. There was little or no water which escaped to the river:—

NAME OF SYSTEM.	Sarf operations commenced.	Sarf operations completed.
Ramadi	October the 6th.	November the 1st.
Asfun	8th to 19th November.	12th to 25th November.
Fadiliyah... ..	10th October to 30th Nov.	14th October to 10th Dec.
Sahil Farshut... ..	13th " " 13th "	24th " " 25th "
Killabiyah	5th " " 12th Oct.	25th " " 30th Oct.
Bayyadiyah	11th October " 10th Nov.	25th " " 20th Nov.
Shanburiyah	17th " " 16th "	25th " " 18th "
Ghilasi	6th " " 11th "	17th " " 17th "

In the Girga Directorate.—The following statement gives the dates of commencement and completion of sarf in the several systems and the dates of opening the Nile Escapes :—

NAME OF SYSTEM	Date of commencement of sarf.	Date of completion of sarf.	Dates on which Nile escapes were opened.
Khiyam... ..	6th Oct. to 27th Oct.	7th Oct. to 18th Oct.	27th Oct. to 2nd Nov.
Akhmin... ..	7th " " 10th "	13th " " 1st Nov.	Not opened.
Kidzandariyah	1st " " 31st "	10th " " 29th "	12th Nov. to 14th "
Abnah	20th " " 12th Nov.	28th " " 10th "	30th Oct. " 17th "
South Sohag	4th " " 20th Oct.	11th " " 10th "	13th " " 28th Oct.
North Sohag	6th " " 6th Nov.	18th " " 18th "	12th " " 29th Nov.

The Galawiyah Escape, Akhmin system and the Motia Shuth and Selim Escapes North Sohag system, were not opened for sarf at all.

In the 4th Circle.—The dates of commencement and completion of sarf in the various systems were as follows :—

NAME OF SYSTEM.	Sarf commenced.	Sarf ended	REMARKS.
Asyut Delgawi.	1st Oct.	20th Oct.	Hod Delgawi 13 November.
West of Yusufi, Asyut	13th Oct.	25th Oct.	
East Ibrahimiyah, Asyut to Deirut.	3rd Oct.	31st Oct.	Sarf delayed to irrigate. Sahels and ghizirehs.
West Yusufi, South System, Minia province.	16th Oct.	31st Oct.	By cuts on to Yusufi & El Der escape.
Etsa System, Minia Province.	14th Oct.	2nd Nov.	Sarf of Hod Deri completed 30th November.
West Yusufi, North System, Minia Province ...	21st Oct.	3rd Nov.	By cut in Tarrad Hariqa and Shinera escape.
Beni Suef Basins	28th Oct.	20th Nov.	Sarf of Hods Qoshesha and Riqa completed on 5th and 6th December.

Delgawi Escape was opened on the 10th October giving a level of 45.10 in the Yusufi. On the same date the Yusufi Head was closed and the Deirut Escape opened. A flush was sent down the Yusufi on the 7th and 8th October to flood the sahels between Deirut and Badraman. The Inspector of the 4th Circle advocates the abandonment of the practice of sending down this flush which he considers stops the cultivation of the Nabari and is a source of danger to the banks, particularly that of Hod Delgawi, a breach in which when the basin is full would be disastrous. The areas of the Sahels is small and they might be put under Nabari. The discharge from Delgawi Escape flooded all the Yusufi sahels down to Nezlet El Abid Regulator. North of Nezlet El Abid down to Edum the west sahels in Minia Province were surrounded by hoshah banks and flooded from Hods Tukh and Qamadir. North of Edum no water was available as heretofore, from the east chain of basins, so the following cuts had to be made:—

Two cuts in tarrad of Hod Qamadir on 17th October.

One cut in tarrad of Hod Shushah on 18th October.

One cut in tarrad of Hod Terfa on 18th October.

Der escape at the northern extremity of the south system of West Yusufi Basins was opened on the 19th of October. By those means all sahels between Edum and Saqula were flooded.

North of Saqula, Hods Garnusi and Salaqusi not having reached T.R.L., the Gamal and Abu Rahib escapes were replaced by a cut in the tarrad of Hod Hariqa, and by the opening of Shinerah escape. By these measures, assisted by regulation on Mazurah Regulator, the sahels down to Mazura were flooded. The diagram on Plan III shows the passage of the sarf wave down the Yusufi.

The sahels on the east of the Yusufi, between Nezlet El Abid and Mazurah, can be commanded by the new Sefi canals now being constructed in the Minia basins east of the Yusufi. The western sahels might either be given pumps or fed through culverts from the western basins. The irrigation of the sahels being disposed of it would be possible to run off the sarf water in the Yusufi at a low level and thus render drainage into the Yusufi possible during the greater part of, if not during the whole, flood season.

Mazurah Regulator was fully opened on the 21st of October and the sarf water reached Lahun on the following day, covering all the sahels on its way. The regulator was then closed again till Hod Sultani was full. Opening of Qoshesha Escape began on the 28th of November, the orders being to let the level in the hod drop at the rate of 20 centimetres par day. By the 5th of December all the lower gates had been raised three metres.

The east abutment and wings, and six vents of the new Talihat Regulator on the Solagiyah Canal, failed owing to having been out-flanked on the 6th of October. The regulator was holding up 3 metres of water at the time. This regulator was only completed in July 1902. A commission of enquiry found that the failure was due to defective filling behind the abutment and careless watching. The masonry work of the regulator was first rate and it was more than annoying that the failure should be due to the above causes. The native engineer in charge of the superstructure has since been dismissed. Accidents during flood.

Several attempts to interfere with regulation were made during the flood; thus the villagers of Aleinat, in Kema, forcibly opened Samhud Escape and closed the Rushwaniyah Regulator at Abu Shushah. The west bank of the Khizindariyah Canal in Badari west basin was cut on October the 18th which led to the premature sarf of the basin. The tarrad of Hod Hammam was cut on the 9th of November, inducing premature sarf. The breaches which occurred in Hods Shushah and Qamadir have already been alluded to. The noses of the piers of Abu Shusha Feeder were blown off by back pressure from the Hod.

New works shown to be necessary during recent flood seasons.

On pages 109 to 112 of last year's Report was given a list of works for improving flood irrigation. The list included 34 works in the 5th Circle, 30 works in Girga Directorate, and 7 works in the 4th Circle. During the year items 6, 11, 15, 20, 21, 28 and the culvert mentioned in item 30 were built in the 5th Circle leaving items 1, 5, 7-10, 12-14, 16-19, 22-27, 29, the bank included in item 30, 31-35, to be still carried out.

In Girga Directorate items 4, 6, 7, 23, 26, 30, 37 were disposed of during the year leaving the following items to be dealt with 3, 5, 8-10, 12, 14-18, 22, 24, 25, 27, 29, 31, 36. In the 4th Circle the 7 items included in the list were completed, or, in the case of item No. 1, taken in hand during the year. The following list shows some additional items proposed by inspectors. Serial numbers are given to the several items in continuation of the list in the Report for 1901.

Serial Number.	Circle.	Province or basin system.	DESCRIPTION OF WORK.
36	5th.	Ramadi,	Feeder for Ramadi canal below Maama-riyah regulator.
37	"	Asfun	Sayyala taking off at kilometre 79,500 Ramadi Canal along Matraba of Salibah Hod Musallas to feed east portion of Hod Asfun.
38	"	" "	Remodelling and extending Unm Adas canal to feed Hods Muhamid Reitti and El Makar.
39	"	Fadiliyah	Resumption of old head of Fadiliyah canal as the sand bank blocking it has moved down-stream.
40	"	" "	Malgar Sayyala to connect Hod Dabiyah with southern hods of the system.
41	"	" "	Widening Tukh Der canal to 120 metres and increasing water-way of syphon under Ramnan canal.
42	"	Sabil Farshut ...	Widening Ramnan canal to 200 metre bed and its west branch to 80 metre bed to feed Hod Samhud. Widening Dumra-niyah canal to 80 metre bed from kilo-metre 8600 to the Salibah regulator.
43	"	Bayyadiya	Widening Maala canal to 120 metre bed and remodelling its syphon under Bayya-diya canal to increase supply for Hods Gabbannah Hibel, Karnak and Ashi.
44	"	Ghilasi	Extension of Ghilasi canal southwards in Khar Kema to join Sheikhhiyah canal re-modelled, and junction of Samata canal with the re-modelled Ghilasi canal.
38	Girga Dir.	South Sohag ...	Regulator in right bank of Kusra canal opposite tail of Abu-Steir Sayyala for Hod Bardis East.
39	"	" "	Head regulator for Hakmi Sayyala Girga-wiya canal Hod Sohag East.
40	"	North Sohag ...	Project for improvement of irrigation of Hods Awlad Nusseir, Muftin, Baga and Qilfaw.
41	"	" "	Culvert in tarrad of Hod Muftin to irrigate Sahel Geziret Shandawil and Qaramuta.
42	"	" "	Culvert in Salibah Tuna to irrigate Ha-mada Hoshah.
1	4th.	" "	Old feeder to Hod Nasrani from Ibrahi-mich to be opened up and repaired.
2	"	" "	One or two small culverts in the banks of Beni Hussein canal.
3	"	West Yusufi ...	Some small culverts in tarrads of hods on west of Yusufi to irrigate hoshahs on sahels.
4	"	" "	An escape in tarrad of Hod Hariqah.
6	"	" "	Alteration of feeder heads West Yusufi Basins to drainage culverts.

The following statement shows the expenditure incurred on special measures for prevention of "Sharaki" : —

Special Sharaki measures and expenditure.

CIRCLE.	EARTHWORK EXECUTED.		Expenditure on Sundries.	Total Expenditure.
	Cuts.	Cost.		
	£M.	££.	££.	££.
5th Circle	552,617	9,234	466	9,700
Girga Directorate ...	271,779	4,322	399	4,721
4th Circle	333,102	3,417	1,211	4,658
Totals	1,157,498	17,003	2,076	19,079

The works consisted in constructing new distributary channels, deepening existing ones, and in surrounding the higher portions in the hods and river sahels with banks. Some of these works were of a temporary nature, others will remain as permanent improvements. The expenditure on sundries included transport of labor and hire of a steam tug and dahabieh in the 5th Circle. In the 4th Circle pumping for irrigation of Hod Walidayah cost £E.797; a special credit of £E.14,450 was obtained from the Caisse de la Dette to meet this special expenditure. The balances remaining unpaid from the total of £E.19,079 at the end of the year were as follows:—

	££.
In the 5th Circle... ..	2,600
In Girga Directorate	220
In 4th Circle... ..	398
Total... ..	<u>£E. 3,218</u>

The figure of £E.4,658 includes a sum of £E.1,204 charged to the Ordinary Budget and included in appendix D.

The Sharaki area avoided owing to the works done is estimated at 77,773 feddans.

The estimated Sharaki areas are as follows:—

PROVINCE.	SHARAKI AREAS.		TOTAL.
	Hods.	River Sahels and Islands.	
Aswan	9,905	13,902	23,807
Kena	42,850	5,110	47,960
Girga	4,428	7,286	11,714
Asyut	4,924	4,770	9,694
Minia	—	2,187	2,187
Beni Suef	302	1,727	2,029
Totals... ..	62,409	34,982	97,391 (a)

NOTE (a). From the most recent figures received from the Sharaki commission it appears probable that the area of whole sharaki in Upper Egypt will be about 102,000 feddans and the area of half sharaki 55,000 feddans.

The following statement gives the total whole sharaki areas for the three previous lowest years of 1877, 1888, 1899:—

PROVINCE.	WHOLE SHARAKI AREAS.		
	1877.	1888.	1899.
Aswan	62,000	5,418	12,401
Kena	257,883	113,938	79,254
Girga	267,114	78,303	41,649
Asyut	114,866	43,956	23,502
Minia	45,339	22,876	13,979
Beni Suef	6,790	4,619	8,137
Total	753,992	269,110	188,137

Even if the results of the Sharaki commission raise the total area by as much as 25 %, which is improbable, the result will still remain very satisfactory as one cannot say that the flood was distinctly better than those of either 1888 or 1899.

SECTION. IV. — FLOOD WATCHMEN.

Nile Corvée.

The total number of men called out was 20,299. The average number of days they remained out was 23. The total number of days' labour was 470,569. The number of days' labor in 1899 when the flood levels were practically the same was 666,169. The distribution of the flood watchmen is shown in the following statement. In low floods watchmen, particularly in the southern provinces, are needed more to prevent the wilful cutting of banks than to protect them against water action. The lower the flood the greater the likelihood of the banks being transferred with.

NUMBER OF CONVEE MEN CALLED OUT DURING THE NILE FLOOD OF 1902.

	NILE BASIN.						CAVAL BASIN.				BRIDGES.				DEMERS.		TOTALS.	
	Number of men called out.	Average number of days out.	Length of banks in kilometers.	Average number of men per kilometer.	Number of men called out.	Average number of days out.	Length of banks in kilometers.	Average number of men per kilometer.	Number of men called out.	Average number of days out.	Number of bridges.	Average number of men per bridge.	Number of men called out.	Average number of days out.	Number of men called out.	Average number of days out.	Number of men called out.	Average number of days out.
4TH CIRCUIT.																		
Fayum...	181	35	34.943	19	1019	17	105.299	8	89	14	46.500	4	45	89	180	45	3.629	24
Beni-Suef...	113	38	907	1	1239	21	384.000	3	142	37	113.000	1	147	47	3.091	19	3.091	19
Minia...	45	14	65.783	1	1255	22	159.845	8	336	39	131.975	2	568	52	2.024	33	2.024	33
Ayut North...	389	—	106.726	7	5628	—	605.641	8	747	—	300.811	10	580	—	8.664	—	8.664	—
Total...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PROVINCE CHICIAL.																		
Assut...	—	—	—	—	—	—	—	—	3065	21	—	—	—	—	—	—	3.065	21
Minia...	—	—	—	—	—	—	—	—	3468	14	—	—	—	—	—	—	3.468	14
Total...	—	—	—	—	—	—	—	—	6533	—	—	—	—	—	—	—	6.533	—
5TH CIRCUIT.																		
Kenn...	80	31	45	2	38	21	22.929	2	5	16	3	2	274	41	2639	26	2.45	23
Assut...	—	—	—	—	—	—	—	—	—	—	—	—	32	50	30	3	332	3
Total...	80	—	45	—	38	—	22.929	—	5	—	3	—	306	—	2339	—	2.789	—
6TH CIRCUIT.																		
Assut South...	213	29	151	1	187	34	100	2	117	45	191	1	178	69	2	19	711	12
Giza...	118	32	228	1	137	39	292	1	166	18	533	1	358	65	—	—	1.639	39
Total...	331	30	379	1	324	25	392	3	282	21	625	1	536	66	2	19	2.353	—
Grand Totals...	880	—	629.726	—	4730	—	1111.504	—	8189	—	1000.811	—	1422	—	1678	—	20.290	23

SECTION V.—DRAINAGE.

All new drainage channels made during the year will be described under the head of "Special Works." In the clearance of drains a cube of 274,863 M³ was executed at a cost of £E.3,415.

Levels of
Lake Qarūn.

The following table gives the levels of Lake Qarūn on the 1st of March for the past 19 years:—

YEAR.	Level of lake in metres below sea-level.	Fall in previous 12 months.	YEAR.	Level of lake in metres below sea-level.	Fall in previous 12 months.
1885	37.89	Unknown.	1894	43.84	0.06
1886	40.00	0.20	1895	44.17	0.33
1887	40.38	0.38	1896	44.16	0.11 rise,
1888	40.73	0.35	1897	44.27	0.11 fall.
1889	41.17	0.44	1898	44.32	0.05 "
1890	42.00	0.83	1899	44.25	0.07 rise,
1891	42.78	0.78	1900	44.10	0.15 "
1892	43.32	0.54	1901	43.90	0.20 "
1893	43.78	0.46	1902	44.19	0.29 fall.
			1903	44.43	0.24 "

The aggregate fall during the past two years has been 0.53. It may be noted that the short flood supply necessitated mild rotations in the Fayoum last September. With better floods and improved drainage the lake may show a tendency to rise but it does not look as if any serious fluctuation need be anticipated.

Part. II.—SPECIAL WORKS.

(Chargeable to Special Caisse Credit and to Special Grant from Ordinary Budget.)

The sum available for expenditure on Special Works during the year was £E.420,333.159 made up as follows:—

	£E.	Mill.
Special Caisse Credit... ..	405,543	466
Special Grant from Ordinary Budget	14,789	693
Total	<u>£E.420,333</u>	<u>159</u>

The total expenditure was £E.418,105.405 leaving a balance of £E.2,227.754 to be carried forward. The sum actually carried forward will be £E.2,227.439 as the balance of £E. 0.315 on the Special Grant from Ordinary Budget will lapse.

Appendix F gives a general abstract showing the partition of the expenditure on the various projects. Appendices G and H give lists of the various masonry works, the new channels and banks constructed, and the existing channels re-modelled during the year.

The projects taken in hand or advanced during the year were as follows:—

In the 4th Circle.

West of Yusufi Basins, Minia Province.

Mazurah Regulator and Lock, Beni Suef Province.

Extension of West Mohit Drain across Hod Sultani to escape into Bahr Yusef below Mazurah Regulator, Beni Suef Province.

Construction of Walidiyah syphon under Ibrahimieh canal, Asyut Province.

Construction of Magnuna Syphon, Beni Suef Province.

Remodelling branches of Ibrahimieh canal, Asyut Province.

Supplying iron gates and lifting gear for Ibrahimieh canal at Deirut Regulator.

Construction of Beni Khalid Canal and Hoshah Tunah, Asyut Province.

Fayoum re-modelling Projects.

In the Projects Circle:—

Conversion of Asyut Basins east of Bahr Yusef into perennially irrigated tracts.

Conversion of the southern Minia Basins east of Bahr Yusef into perennially irrigated tracts.

Widening the Ibrahimieh Canal.

Remodelling Mohit Drain.

Etsa Pumping Station.

Conversion of northern Minia Basins east of Bahr Yusef.

Beni Suef Basins, and West Gizeh Basins.

In the 5th Circle:—

Faw and Hamad Escapes.

In Gharq Directorate:—

Talihat Regulator and contingent works.

West of Yusuf
Basins.

Work on this project was started in 1899 and completed during 1902. The items on which expenditure was incurred during the year were the following:—

1° Completion of iron work of Nezlet El Abid and Saqula Regulators.

2° Construction of three new regulating bridges in Salihahs Nezlet El Abid, Takh and Qanadir, to provide extra water-way through the southern chain of basins to feed the northern chain.

3° Payments for land.

4° Completing revetment of basin banks.

5° Construction of quarters for regulating staff, and magazines at Nezlet El Abid and Saqula.

The total expenditure during the year was £E.19,433 which brings the total expenditure on the project up to £E.211,013. The Project Estimate amounted to £E.200,000. Both north and south systems of basins were successfully filled during the flood.

Masrah
Regulator and
Lock.

This regulator, which consists of 25 3-metre vents with a lock channel spanned by a lift bridge, was commenced in 1900 and completed in 1902. The expenditure during the year was £E.2,478 incurred on the following items:—

1° Erection of lock gates and lift bridge.

2° Rubble revetment down-stream of regulator.

3° Quarters for regulating staff and magazine.

The total expenditure on the work has been £E.55,589. The regulator did excellent service during flood in preventing Sharaki in the Beni-Suef basins and also greatly improved the drainage of the perennially irrigated tract in Fashin Markaz by enabling the Mohit Drain to discharge into the Yusufi with one short interruption during flood.

This work was commenced in 1901 and completed during the year. It consists of an escape channel of 10 metres bed width. The channel discharges into the Yusufi below Mazurah Regulator over a tail fall. At the head of the channel comes a regulating bridge by means of which the discharge of the drain can be diverted to the Nile at Sharana, where there will be a pumping station if it be found impossible to keep the level in the Yusufi below Mazurah low enough to permit of the escape at the tail of the drain working for any portion of the flood season. Lower down the channel comes another 3-span bridge and a syphon consisting of 3 2-metre pipes. At present the flood discharge from the Yusufi for the Beni Suef Basins passes over this syphon and in future the same passage will serve for a selt canal. The syphon is provided with screw doors to keep out water from the Yusufi if necessary during flood. The escape worked most satisfactorily during the past flood, the discharge only being interrupted for eleven days, to the great benefit of the Minia perennial tract. It appears probable that by completing the chain of basins west of the Yusufi in the Beni Suef Province, it may be possible to keep the level below Mazurah Regulator sufficiently low throughout the flood season to admit of this escape working uninterruptedly. This would do away with the necessity for a pumping station at Sharana. This station would cost at least £E.70,000, and the annual working expenses would be about £E.5,000. Hence if it can be shown that by constructing the chain of Beni Suef Basins the pumping station could be suppressed the immediate construction of these basins would be justified. The expenditure on the escape channel during the year was £E.7,647 and the total expenditure up to date £E.12,750.

Extension of
West Mohit
Drain to Bahir
Yusuf.

The object of this work was explained in last year's report. The first attempt to sink the pipes proved unsuccessful, as when down it was found that the bolts of one joint in each pipe had been sheared. So the pipes had to be raised again. The approach of the flood did not admit of a second attempt to sink the pipes being made. This syphon would have been of the greatest service during the past low flood. An

Wadidiyah
Siphon.

early start will be made with the work in 1903. The expenditure during the year was £E.2,241 and up to date £E.3,741.

Magna
Syphon.

This was completed during the year and worked satisfactorily during flood. The expenditure incurred was £E.219 and the total expenditure on the work £E.669.

Remodelling Branches of Ibrahimieh Canal.

Under this head the following works were carried out:—

	£E.
1 ^o West Hafiz Ghannabiyah for irrigation of land north of the Sabakhah canal	4,140
2 ^o Distributary from the Deirutiyah canal south of Sabakhah canal	561
3 ^o Head for East Hafiz Ghannabiyah for irrigation of tract east of the Ibrahimieh canal from Hafiz Regulator to Mansafis.	1,034
4 ^o Drainage culvert under the Railway at Hafiz to serve area between the Railway and Ibrahimieh Canal	120
5 ^o Regulating plank for Walidiyah canal land sluice	70
6 ^o Masonry heads to pipe sluice of El-Milk canal	
Total...	<u>£E.5,925</u>

Grates and
lifting gear for
Ibrahimieh
Canal
Regulator at
Deirut.

This much-needed work was completed during the year at an expenditure of £E.2,497, of this £E.775 was recovered by the contractor on account of old Government plant purchased by him.

Construction
of Beni Khalid
Canal and
Hoshah
Tunn.

As noted in last year's report the flood section of the Yusufi had been reduced by the conversion of the eastern basins along it into perennial tracts, through which it was no longer possible to pass flood water. On the other hand the creation of the West Yusufi Basins, which cover a large area, formerly only flooded during sarf, has increased the demand for water in the Yusufi during August and September. A good deal of trouble was experienced on this account in 1901 when it was found necessary to keep the gauge at the head of the Yusufi 40 centimetres lower than in previous years. The most contracted section of the Yusufi channel lies between the head of the abandoned Itqa Canal and the tail of the Asyut West Yusufi Basins, which is Hod Beni Khalid Salibah. North of this salibah comes a wide sahel which serves to relieve the main channel in flood. To increase the carrying power of the Yusufi in the contracted section a canal of 20-metre bed width has been made through Hod Beni Khalid. This canal is fed by an open head in the Yusufi tarrad spanned by a girder bridge. At the tail of the canal in Salibah Beni Khalid a six-vent escape has been made.

In connection with the above work it was considered advisable to reduce the head on Salibah Tunah, the southern boundary of Hod Beni Khalid, by dividing up Hod Tunah and so reducing the T.R.L. of the northern half. This was done by constructing a salibah with a regulating bridge in it across Hod Tunah south of Dirwah canal head. To afford a red water supply to the Hoshah so formed a feeder head was built in the Yusufi tarrad. The above works were completed before the flood and worked satisfactorily. The expenditure was as follows:—

	£E.
Beni Khalid Canal	5,767
Hoshah Tunah	1,775
Total...	<u>£E.7,542</u>

The land taken up has still to be paid for.

The projects dealt with in the Fayoum during the year were as follows:—

Fayoum
Remodelling
Projects.

1. Completion of Hassan Wassif Canal.
2. Completion of remodelling of Bahr Nezeleh and Branches.
3. Completion of remodelling Tagin Drainage System.
4. Remodelling of Bahr Seilah and Branches.
5. Minor Projects.
6. Inspection Houses.

Hassan Wassif Canal.—During the year a sum of £E.4,655 was paid for land. This brings the total cost of the work up to £E.61,865.

Remodelling Bahr Nezet and Branches.—Under this head the following items of work were carried out. Completion of 2nd reach of Bahr Nezeleh; completion of 3rd reach of Bahr Kasr El Banat; two falls on Bahr Shellan. A payment of £E.1,701 was also made on account of the Tagin Aqueduct which carries the Bahr Nezeleh over the main Tagin Drain. The total expenditure on the project during the year was £E.9,849 and the expenditure up to date £E.67,365.

Remodelling Tagin Drainage System.—The remodelling of this system was completed during the year at an expenditure of £E.17,790. The total expenditure on the project has been £E.33,402.

Remodelling Bahr Seilah and Branches.—The remodelling of the 1st reach of the Bahr Seilah, commenced last year, was completed. The first reach, 15 kilometres in length, and a portion of the second reach of the important Abdullah Wahbi canal, to serve the Kharig El Zinnan lands in the south east of the province, was completed. The

masonry works included a railway bridge over the Abdullah Wahbi Canal, one regulator, two falls, and three road-bridges. The expenditure on the project during the year was £E.45,762 and the expenditure up to date £E.48,462.

Minor Projects.—Under this head the following items were executed:—

	£E.
Government share of road railway and bridges over branch canals	1,452
Pipe syphon under Hassan Wassif Canal for Hawara Canal...	248
Aqueduct over Hassan Wassif Canal	200
Completion of Metartaris Alam Project	541
Remodelling Abu Awad Drain	816
Constructing Shallan Drain Bahr Nezlet System	2,792
Total...	<u>£E.6,049</u>

Inspection Houses.—Two Inspection Houses were commenced at Abu Awad on the Bahr Nezleh, and at the head of Bahr Serb, a branch of the Abdullah Wahby canal. A partial payment of £E.570 was made for the two.

Conversions of
Aayut Basins

The greater number of the irrigation channels and drains were completed in 1901, and the flood and winter irrigation of the converted basins effected through them. The working season is however too short to complete the systems of canals and drains in all details. Hence during the past year the following additional items of work were carried out:—

NAME OF WORK.	EXPENDITURE.
	£E.
Strengthening banks of distributaries	8,700
26 kilometres of new distributaries and drains	2,899
Masonry Works	11,272
Irrigation outlets... ..	1,725
Boundary stones	133
Payments for land	16,410
Working canals	954
Miscellaneous	54
Total... .. £E.	<u>42,147</u>

Expenditure was also incurred on payment for land and working the canals during the flood and winter.

This brings the total expenditure on these basins up to £E.177,182. Sirry Bey considers that five small extensions of channel, two new

channels, and one syphon are required to complete the system. The cost of these is estimated at £E.5,000. £E.1,600 is still due for land. It will require about £E.4,000 to complete the irrigation outlets. At first earthenware pipes or timber shoots are laid in the banks. The position of many of these has to be altered to suit land boundaries. Last year all the outlets on the main channels were provided with masonry heads and wooden shutters. This work will take several seasons to complete. It is advisable to proceed slowly with it, making certain that the outlet is correctly placed before constructing it in masonry. Taking the above items into account it appears probable that the total expenditure on these basins will reach £E.187,782 which gives a rate of £E.3.233 per feddan of converted area. This figure does not include any expenditure on the feeder canal of the system, which, in this instance, existed in the Deirutiyah canal, or on the main drainage escape, in this instance, the west Mohit Drain.

An area of 4,000 feddans in these basins was put under sefi crop and irrigated from the Deirutiyah and Bahr Yusef. Sirry Bey quotes an instance of cotton in Hod Akminim giving a yield of 9 kantars per feddan. The area put under flood durah was 36,000 feddans or 68% of the total area. It is said that the average out-turn was 16 ardebs per feddan and reached 24 ardebs, which is very high.

The three basins of Tanashawi, Quran and Tahawi, aggregating 53,237 feddans, were taken in hand. Work was started at the beginning of February and completed at the beginning of August.

Conversion of
Southern
Minia Basins.

The lengths of channel made were as follows:—

DESCRIPTION OF CHANNEL.	Length in metres.
Sabakhah main canal and Fellahin canal with bed widths ranging from 19.0 to 14.0 metres	44,800
Irrigation channels with bed widths at head of from 4.0 to 1.5 metres... ..	63,100
Irrigation channels having bed widths at head of from 1.0 metre to 0.50 metre	192,000
Drains with bed widths at tail of from 3.0 metres to 1.0 metre.	53,000
Drains with bed widths at tail below 1.0 metre	155,800
Total... ..	508,700

The number of masonry works built was 230 detailed in Appen. G. The total expenditure incurred was £E.140,219. Adding the expen-

diture of last year the expenditure up to date becomes £E.155,541. The estimated further expenditure for land payments, extension of distributaries and drains, new masonry works, and irrigation outlets, amounts to £E.83,700. It appears probable therefore that the final figure for expenditure will amount to £E.239,241. Out of this total a sum of £E.71,348 was spent on the main Sabakhah canal which leaves £E.167,893 as the final figure for expenditure on the system of distributaries and drains. This gives a rate of £E.3.153 per feddan of converted area.

Water was admitted to the canals at the beginning of August. Cholera was raging in the district, which apparently prevented the officials of the Mudirieh from giving any assistance in the way of inducing the cultivators to make field water courses, and rendered the latter restless and apathetic. The result was that only 12,000 feddans were put under durah, which was not as good a start as was made in the Asyut Basins last year. The absence of water courses made irrigation difficult, rendering it necessary to construct hoshahs. The shitwi crops are generally reported to be excellent and much superior to those obtained when the land was under basin irrigation.

Widening
Ibrahimieh
Canal.

During the summer of 1901 as much work as possible was carried out in the Minia to Etsa reach. The canal was closed at Minia from the 15th of December 1901 to the 15th of January 1902 when a cube of 295,948 M³ was removed from the bed in this length. Out of this quantity a cube of 93,986 M³ was paid for in 1901, and the balance was paid for in 1902. 11,118 M³ of rubble revetment was also done in the left water slope of the canal. During the summer of 1902 work went on in the reach between Etsa and Matay and a cube of 1,228,356 M³ was executed. The canal was closed at Minia for 30 days from December 1902 and during this closure the widening from Minia to Matay, a length of 40 kilometres, was completely finished. The work done during this closure will appear in the report for 1903. The expenditure during the year amounted to £E.33,842.870 and the total expenditure up to date to £E.61,914.552. A contract was made at the end of the year with the Behera Company for widening the canal between Deirut and Minia partly by hand work, partly by dredging, which work is now in hand and, according to the terms of the contract, should be completed at the end of 1905.

Remodelling
West Mohit
Drain.

The west Mohit Drain will be the main drainage channel for the whole area in the Asyut and Minia Provinces included between the Bahr Yusef and Ibrahimieh canal. In summer and winter its discharge

will be escaped to the Nile at Etsa, Kolosda and Sharanah. In flood water will be lifted into the Nile by pumping stations at the above sites, or will be escaped into the Bahr Yusef below the Saqla and Mazurah Regulators. During the year the remodelling of the reach, 40 kilometres in length, between the head of the drain at Salibah Itqa, and the Etsa Canal was completed at a cost of £E.26,681. This reach serves an area of 166,747 feddans.

The contract for the plant for this station was placed last year with Easton and Company, Erith Works, Kent. Work on the station was commenced in June and nearly carried up to floor-level before flood. Work was then interrupted owing to the cholera which carried off one of the contractors. The plant had all arrived by the end of September. Work was resumed in December, and the erection of the machinery was started early in January 1903. The station will be ready for working during the flood of 1903. This station is designed to lift 8 cubic metres per second. The expenditure during the year was £E.11,477 and up to date £E.17,039.

Etsa Pumping Station.

The project for the conversion of the Northern Minia Basins was studied in detail during the year. The area of these basins aggregates 56,200 feddans. The tract included in Hods Qoshesha and Riqqah and the West Gizeh Basins aggregating 202,000 feddans, was surveyed and levelled over during the year, and a large scale contoured plan prepared. The project will be ready for submission in 1903. The project for the conversion of the Beni Suef Basins down to Salibah Babashin has already been approved of.

Conversion of Northern Minia Basins, Beni Suef Basins, and West Gizeh Basins.

In the 5th Circle the small balance of £E.189 on the Special Caisse Credit for 1901 was spent in payments for land for Faw and Hamad escapes.

Faw and Hamad Escapes.

These works were completed during the year at an expenditure £E.13,000. The expenditure up to date has been £E.25,000. The unfortunate failure of a portion of this regulator has been alluded to before.

Tulihat Regulator and contingent works.

Part III.—WORKS AND ESTABLISHMENT.

SECTION I.—MAINTENANCE AND REPAIRS.

Details of the quantities of earthwork executed during the year and its cost are given in Appendix D. The total quantities are as follows:—

CIRCLE.	BY HAND.		DREDGING.	
	Quantity.	Cost.	Quantity.	Cost.
	C.M.	£E.	C.M.	£E.
4th Circle	4,532,536	55,897	108,015	7,302
5th Circle	2,685,670	33,872	—	—
Girga Directorate ...	2,442,272	26,505	—	—
Totals... ..	9,660,478	116,274	108,015	7,302

The cube in the 4th Circle shows a considerable reduction. In the 5th Circle and Girga the cube is about normal. A sum of £E.623 is due on the cube in the 5th Circle. Girga Directorate paid off arrears of £E.365 on account of 1901. The average cost per cubic metre was as follows:—

4th Circle	1.23
5th Circle	1.28
Girga Directorate	1.07

The above rates are quite normal. The following table shows the quantities dredged in the Ibrahimieh Canal during the last 12 years:—

YEAR.	QUANTITY IN CUBIC METRES.			COST IN £E.
	Assut to Beirut.	In the river at Assut.	Total.	
1891	836,116	—	836,116	30,591
1892	413,088	—	413,088	15,597
1893	371,926	—	371,926	14,400
1894	448,026	—	448,026	16,888
1895	351,253	—	351,253	13,225
1896	300,706	—	300,706	11,347
1897	214,212	—	214,212	8,196
1898	247,813	—	247,813	9,374
1899	129,367	—	129,367	4,872
1900	201,656	66,925	268,581	10,555
1901	312,457	147,079	459,536	16,000
1902	108,015	—	108,015	7,302

In the sum of £E.7,302 is included an amount of £E.1,232 paid for work done in 1901. The actual cost of the 108,015M³ was therefore £E.6,070. The old contract with Messrs. Du Port and Jones ended in December 1901, and a new one was made for five years on a sliding scale of rates. Hence the higher cost for the small cube in 1902 as compared with previous years.

There was no expenditure on spurs in the Ibrahimieh Canal during the year. Spurs in Ibrahimieh Canal.

The following statement shows the cubes of stone purchased and built into river spurs and revetments during the year and the expenditure incurred on transporting and building Government stone into the same:— River Protective Works.

CIRCLE.	NEW STONE.		Expenditure on transporting & building Gov. Stones & arrears.	Total Expenditure.
	Cube.	Cost.		
	C.M.	£E.	£E.	£E.
4th Circle	8,355	1,433	72	1,507
5th Circle	3,756	414	373	787
Girga Directorate ...	5,628	1,077	312	1,389
Totals... ..	17,739	2,926	757	3,683

In the 5th Circle arrears to the amount of £E.356 were paid on account of 1901. The arrears due on the work done in 1902 are £E.407. In Asyut Province the Manjabed Beni Amram and Raramun spurs were repaired at a cost of £E.510. In Minia Province two small spurs were made at Matalra, some new revetment at Ikhsas, and the revetment at Minia was repaired. In Beni Suef Province expenditure was incurred on new revetment at Halabiyah, and repairs to Wasta spurs. In the 5th Circle the bulk of the work was done at Nag Hamadi south of the railway bridge where there is a good deal of river action. Small lengths of revetment were also done on the right bank of Asfun Canal, and the tarrad of Hod Hew, where the river impinges on them. In Girga Directorate the spurs at Solag, Kitkata, Qaramta, Abnub, and Tuca were repaired. Short lengths of new revetment and repairs to existing revetments were executed at 16 different sites.

The following expenditure was incurred in revetting canal banks below regulators and at other important points:—

CIRCLE.	New stone.		Transporting & building Gov. stone and masonry.	Total expenditure.
	Cube.	Cost.		
	c.M.	£E.	£E.	£E.
4th Circle	9,911	2,805	46	2,851
5th Circle	2,690	835	191	1,026
Girga Directorate ...	1,914	472	43	515
Totals... ..	14,515	4,112	280	4,392

The points on which banks were protected by revetment were as follows:—

In Kena Province at Farhana Khiba and Hamad Escapes.

In Girga Province various regulators.

In Asyut Province various regulators and west bank of the Ibrahimieh Canal.

In Minia Province Yusufi diversion at Saqula, banks of Safsafa Canal.

In Beni Suef Province head of Sultani canal, east bank of Sharana Canal at Bibeh.

In Fayoum Province below Hassan Wassif Canal Head; banks of Yusufi in Fayoum Town.

SECTION II.—NEW WORKS AND IMPROVEMENTS.

(Exclusive of Special Works).

Earthwork

The quantity and cost of earthwork executed in new channels and banks was as follows:—

CIRCLE.	New Channels and Banks.			
	Cube.	Cost.	Cost of land.	Total cost.
	c.M.	£E.	£E.	£E.
4th Circle	84,517	1,126	—	1,126
5th Circle	84,230	997	—	997
Girga Directorate ...	55,438	633	260	893
Totals... ..	224,185	2,756	260	3,016

The lengths of the new channels and banks are given in the following statement :—

CIRCLE.	LENGTH IN KILOMETRES.	
	New Channels.	New Banks.
4th Circle	7,237	2,179
5th Circle	12,477	—
Girga Directorate... ..	4,103	1,126
Total	23,817	3,305

The works were all petty the details of which are given in Appendix E.

Appendix K shows the progress made with and expenditure incurred on revetting basin banks. In the 4th Circle out of the length of 40,288 metres, shown as done during the year, a length of 31,006 was done in the west of Yusufi Basins at a cost of £E.13,624 which comes under the head of "Special Works." The balance of the revetment in the 4th Circle was executed on the tarrad of Hod Delgawi, and the banks of the Mohit Drain escape in Hod Sultani. Owing to the Conversion of basins the revetment on several salibahs in Asyut and Minia Provinces has been removed so the total of 188,634 metres in the 4th Circle is slightly in excess of the truth. In the 5th Circle a length of 915 metres revetment was done on behalf of the Daira Sanieh Administration at a cost of £E.500. Hence the expenditure on basin bank revetment charged to ordinary Budget was £E.6,721 plus £E.133 spent for purchase of stone not yet built into revetment which brings the total expenditure on the ordinary Budget under this head to £E.6,894.

Basin Bank Protection.

A list of new masonry works and buildings charged to the ordinary Budget is given in appendix B. These were twelve works built for the improvement of irrigation and drainage not counting a number of small falls on road-side drains in the Fayoum. The total expenditure under this head was £E.4,967.

New Masonry Works for Irrigation.

Appendix C gives a list of masonry works repaired and remodelled. The total expenditure incurred was £E.10,158. The only work of much importance was the Takh Salibah Bridge, west of the Yusufi. This bridge is in very sandy soil and the floor failed during the flood of 1901. The damaged floor was rebuilt with a row of sheet piling at

Masonry Works remodelled and repaired.

its extremity. A line of heavy blocks was laid in extension of the floor, below which a talus of rubble pitching was put in. After these alterations the bridge stood the action during the past flood well. The well fall at the tail of Mohit Drain escape was altered by replacing the two vents on the up-stream side separated by a pier by a single vent spanned by an arch. This has rendered the work much stiffer.

SECTION III.—AGRICULTURAL ROADS.

The expenditure on construction of new roads in the Fayoum Province during the year was £E.574 on account of payments for land previously taken up. The following statement shows the progress made with the programme of new roads in the Fayoum approved of in 1898:—

Length included in 1898 programme.	Constructed up to end of 1901.	Constructed during 1902.	Total to end of 1902.
Kilometres.	Kilometres.	Kilometres.	Kilometres.
222.0	113.5	7.0	120.5

The seven kilometres shown as constructed during the year is a portion of the bank of the Abdulla Wahby Canal which replaces the Seilah-Demoo road of the programme. Last year the bank of the Hassan Wassif Canal replaced the Haweret El Makta-Lahun road of the programme 11 kilometres in length. Now that the new channels in the Province are approaching completion road construction, practically suspended for the past two years, can be proceeded with. In Minia a cube of 31,805 M³ of earthwork was executed in repairs to roads at a cost of £E.360. Repair gangs costing £E.690 were maintained for the road repairs in Beni Suef and the Fayoum. The kilometrage of roads in the Fayoum at the beginning of the year was 422. It would require a good deal more than £E.1,050, the total expenditure in the 4th Circle, on repairs of roads to keep the Fayoum roads in tolerable order.

SECTION IV.—BRIDGES TO REPLACE FERRIES.

A final payment for the Safai Bridge on Ibrahimieh Canal was made. Contracts were placed for bridges at Abu Qerqus and Sidds. The latter was practically complete at the end of the year, the former is under

construction. These bridges consist of iron girders and timber platforms carried of masonry abutments and iron piles. The expenditure incurred was as follows:—

	£s.
Safai Bridge	51
Sidds... ..	600
Total... ..	<u>£E.651</u>

In Girga Province 19 timber bridges on masonry abutments and piers were built at a cost of £E.9,420. These bridges are paid for by a cess on the cultivated area of the province. Up to date 33 bridges have been constructed out of the original programme of 49. Canal Bridges in Girga Directorate.

SECTION V.—WORKS OF PRIVATE ENTREPRISE.

The line from Miniet El Het to Shawashma, completed in 1901, was opened during the year. The kilometrage of line open is now 162. The condition of the permanent way and rolling stock is far from satisfactory. Agricultural Railways in Fayoum Province.

The season was a very disappointing one for these works. Only dribblets of water entered the high khors of Sobag and Garf Sarhan closed last year. During the year the khors in the island at Rodah and at Sheikh Fadl were closed. These khors are lower and drew a little more water than those first mentioned. An area of 166 feddans is at present rented for cultivation in the four khors mentioned above. Nile Reclamation Works.

The canals and drains in the tract to the west of the central Mohit Bank at the northern end of Feshn Markaz were remodelled at a cost of £E.73,000. The funds for the work were provided by the Daira Administration. The improvement in the area dealt with has been very marked. Feshn Remodelling Project.

SECTION VI.—EXPENDITURE DURING THE YEAR.

An abstract of the expenditure is given in appendix A and is as follows :—

	£E.
Establishment and contingent Charges... ..	36,303
Works	598,143
Total... ..	<u>£E.634,446</u>

Of the expenditure on works the amount accounted for in the several statements in the body of this report, and the appendices amounts to £E.590,115. The balance of £E.8,028 represent the expenditure on payments of arrears for land from previous years, purchase of materials, petty repairs, and temporary establishment which was divided between the several Circles as follows : —

	£E.
4th Circle	4,218
5th Circle	1,934
Girga Directorate	1,876
Total... ..	<u>£E.8,028</u>

SECTION VII. — ESTABLISHMENT.

Mr. Clowes had a heavy year's work in the 4th Circle with an expenditure of £E.134,295 on Special Works besides acting as Inspector General of Irrigation for Upper Egypt during a difficult flood. He was ably assisted by Mr. A. G. Sachs and Abdalla Bey Wahby, Directors of Works. The latter held charge of the Projects Circle during the absence of Sirry Bey, and carried out successfully the irrigation of the converted basins. This is no easy job, as it is very difficult to get the cultivators to do the necessary in the way of making water courses, and the ground is very uneven over large areas. Mr. Ireland held charge of the 4th Circle during the absence of Mr. Clowes on leave, and worked with his usual energy throughout the year. Ismail Bey Sirry got through a heavy year's work in the Projects Circle, particularly when it is remembered that the working season practically terminates at the end of July, and a month at the start is lost in replacing contracts. This loss has been avoided in 1903 by obtaining permission to put the chief items of work in adjudication at the end of 1902. This will greatly facilitate matters. The sharaki areas south of Asyut as compared with previous years of low flood speak well for the management of flood irrigation by Messrs. Sidky Bey in the 5th Circle and Hassan Bey Wassif in the Girga Directorate.

K. E. VERSCHOYLE.

APPENDICES.

APPENDIX A.

ABSTRACT OF EXPENDITURE IN 1902 UNDER THE DIFFERENT SUB-HEADS OF THE BUDGET.

SUB-HEADS OF BUDGET.	EXPENDITURE.				
	4th Circle.	Projects.	5th Circle.	Ginga.	Total.
	£ E.	£ E.	£ E.	£ E.	£ E.
SUB-CHAP. I.—<i>Establishment.</i>					
Classified	9,964	1,949	4,121	3,854	19,888
Hors Cadre	4,400	—	1,335	1,250	6,985
Total, Sub-Chap. I ...	14,364	1,949	5,456	5,104	26,873
SUB-CHAP. II.					
Travelling Allowance	4,118	—	1,202	1,294	6,614
Telegrams	419	—	264	239	922
Dahabiyahs	176	—	438	468	1,082
Office Rent	317	—	79	112	508
Sundries	10	—	34	17	61
Total, Sub-Chap. II ...	5,040	—	2,017	2,130	9,187
SUB-CHAP. III.					
Furniture and instruments	48	—	41	154	243
SUB-CHAP. IV.					
New works	—	—	1,447	979	2,426
SUB-CHAP. V.					
Repairs and Maintenance	9,296	—	3,796	5,306	18,398
SUB-CHAP. IV AND CORVÉE ABOLITION.					
Earthworks and works for decreasing the cost of maintenance of banks and channels	75,391	—	35,500	32,622	143,513
Special new works	9,885	4,905	—	—	14,790
SPECIAL "CAISSE CREDIT."	124,410	265,719	189	12,999	403,317
NEW AGRICULTURAL ROADS	575	—	—	—	575
SPECIAL LOW FLOOD CREDIT	2,850	—	7,100	4,500	14,450
FERRY FUNDS	51	600	—	—	651
SUMS COLLECTED UNDER CANALS ACT. ...	—	—	—	23	23
Total of Works ...	222,506	271,224	48,073	56,583	598,386
Grand Totals ...	241,910	273,173	55,546	63,817	634,446

APPENDIX B.

LIST OF NEW MASONRY WORKS EXECUTED IN 1901 AND THEIR COST,
EXCLUSIVE OF SPECIAL WORKS.

NAME OF WORK.	Cost.	Total per Province.	Total per Circle.
	£ E.	£ E.	£ E.
5TH CIRCLE.			
<i>Works for Improvement of Irrigation.</i>			
KENA PROVINCE.			
Regulator at kilometre 37 of Killabiya Canal	354.225		
Regulator on Qamula Sayyala	203.979		
Head sluice for Sayyala Sahil El Salamiya	143.623		
Head Regulator for El Kasr Canal	530.000		
		1,231.827	1,231.827
GIRGA DIRECTORATE.			
<i>Works for Improvement of Irrigation.</i>			
GIRGA PROVINCE.			
Head sluice Sayyala Akhmim West	272.576		
Head culvert to borrow pits of Salibah Hoshah Sawama...	250.000		
Head Regulator Shattara Canal	1,018.866		
Head Regulator Shenshiß Sayyala	483.270		
Head sluice Sayyala Hawawish east	226.796		
		2,251.508	
ASYUT.—2ND SECTION.			
Culvert in apadu Bank on Sayyala Hoshah Sahil	144.761		
Hoshah Shaqualqil escape	311.247		
		456.008	
<i>Buildings.</i>			
Completion of Director's office at Sohag	539.995		
		539.995	3,247.511
<i>Carried over...</i>	—	—	4,479.338

LIST OF NEW MASONRY WORKS EXECUTED IN 1901 AND THEIR COST,
EXCLUSIVE OF SPECIAL WORKS—*concluded*.

NAME OF WORK.	COST.	Total per Province.	Total per Circle.
	£ E.	£ E.	£ E.
<i>Brought forward...</i>			4,479,338
4TH CIRCLE.			
<i>Works for improvement of Irrigation or Drainage.</i>			
Smutter Bridge over Syphon or Mohit Drain			
Extension in Hod Sultani Beni Suef Province... ..	104,000	104,000	
Constructions of Huddars for Nazzaz along Agricultural Roads Fayoum Province... ..	383,782	383,782	
			487,782
Grand Total... ..			4,967,120

APPENDIX C.

LIST OF MASONRY WORKS REPAIRED AND REMODELLED IN 1902 AND THEIR COST.

NAME OF WORK.	Cost.	Total per Province.	Cost per Circle.	Grand Total.
	£ E.	£ E.	£ E.	£ E.
5TH CIRCLE.				
KESA PROVINCE.				
Esm regulators...	177,970			
Qift regulators ...	55,418			
Old Qanula culvert...	18,131			
Bayayna culvert & Danilqo Saliba Regulator	89,423			
Hemdat siphon ...	11,119			
Namasa regulator ...	11,981			
Aqulta culvert ...	27,914			
Umm Adas regulator ...	17,086			
Hod Esm culvert ...	14,425			
Reitti culvert ...	29,939			
Hod Esm Sayyala Head Regulator ...	29,083			
Mahadada Bridge ...	22,132			
El sixteen Escape ...	16,220			
Matira Sayyala bridge ...	53,010			
Esm Inspection house ...	18,116			
Miscellaneous petty repairs ...	100,073			
		685,053		
ASWAN PROVINCE.				
Naziriya Regulator ...	74,892			
Nile escape Ramadi canal ...	10,681			
Hod Bimban escape...	14,936			
Miscellaneous Petty repairs ...	8,200			
		108,709		
			793,762	
GIRGA DIRECTORATE.				
GIRGA PROVINCE.				
Remodelling Sheikh Mubadir Regulator ...	346,503			
Remodelling Beni Himeh W. Feeder Head...	445,287			
Sohag Irrigation house ...	172,028			
Sohag West escape ...	81,165			
Girgawiya escape ...	30,844			
Awlad Yehya escape ...	56,958			
Banawit head culvert ...	39,304			
Rayayna Sayyala culvert...	30,312			
Heweti canal head Regulator...	34,378			
Isawiya siphon ...	100,617			
Head culvert Sayyala Hawawish ...	20,855			
Head culvert Sahil El Khiyam ...	25,130			
Petty repairs ...	174,992			
Repairing damage to works from fines collected ...	23,495			
		1,581,868		
Carried over...	—	—	793,762	

LIST OF MASONRY WORKS REPAIRED AND REMODELLED IN 1902 AND THEIR COST—*concluded.*

NAME OF WORK	Cost.	Total per Province.	Total per Circle.	Grand Total.
	£ E.	£ E.	£ E.	£ E.
<i>Brought forward...</i>		1,581.868	793.762	
ASYUT, SOUTH.				
Repairs to Aquaduc Regulator	201.369			
Nasbuls for Shurb and Selim escapes... ..	50.755			
Petty repairs	55.538	307.662	1,889.530	
4TH CIRCLE.				
ASYUT PROVINCE.				
Petty repairs to Bridges	260.442			
Supply of Regulator Boards	135.540			
Repairs to Buildings... ..	172.700			
Repairs to Maharrag Bridge	55.800			
Repairs to Umm Afrita Bridge and Rest house	411.220	1,035.702		
MINIA PROVINCE.				
Repairs to Inspection houses	184.507			
Repairs to Bridges	522.769			
Extension of flow of Takh Salibah Bridge ...	3,241.440			
Repairs to Sawada Bridge	280.000	4,228.716		
BENI SUFF PROVINCE.				
Petty repairs to Bridges	524.452			
Painting gates of Qosheshm escape... ..	152.218			
Repairs to Bueh Bridge and Sanyda escape...	200.000			
Repairs to Abadiya Bridge	125.342			
Repairs to Bridge in Salibah Qosheshm ...	145.548			
Alteration of well fall at tail of Mohit Drain escape	120.107	1,267.667		
FAYUM PROVINCE.				
Petty repairs to Bridges... ..	326.743			
Repairs to Inspection houses	166.455			
Alteration of three road bridges	450.000	943.198	7,475.283	10,158.575

APPENDIX D.

EARTHWORK IN MAINTENANCE CHARGED TO REGULAR AND CORVÉE BUDGETS, UPPER EGYPT, 1902.

Province.	Requires to banks.	Clearance of Nile canals and drains.	Clearance of Self canals. Self canals.	Clearance of Self drains and new drains.	Closing of cuts.	Saddle in canals.	New canals and banks.	Requires to agricultural and roads.	Total.	Cost.
	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.	E.E.
4TH CIRCLE.										
Fayum	29,876	—	503,636	115,495	3,543	—	—	—	652,550	9,514,429
Beni Suef	645,235	355,461	466,542	59,626	—	—	—	—	1,526,867	17,226,941
Minia	622,690	114,246	461,354	99,742	25,703	895	—	31,805	1,356,435	16,843,403
Assut	477,785	293,778	306,417	—	8,704	—	—	—	996,684	12,312,446
Dredging Ibrahimieh Canal.	—	—	108,015	—	—	—	—	—	108,015	7,302,340
Total, 4th Circle	1,775,586	673,188	1,845,904	274,863	37,950	895	—	31,805	4,640,551	63,199,559
GIZA DIRECTORATE.										
Giza	535,965	1,221,170	—	—	2,861	8,866	—	—	1,768,862	18,762,493
Assut	333,751	335,250	—	—	4,178	231	—	—	673,410	7,742,525
Total, Giza Directorate...	869,716	1,556,420	—	—	7,039	9,097	—	—	2,442,272	26,505,018
5TH CIRCLE.										
Kena	313,540	1,838,538	7,534	—	5,360	16,460	—	—	2,181,408	27,033,645
Assan	63,476	438,242	—	—	1,488	1,036	—	—	504,262	6,178,678
Total, 5th Circle	377,016	2,276,780	7,534	—	6,824	17,516	—	—	2,685,670	33,872,323
Grand Total	3,022,318	4,946,688	1,853,438	274,863	51,813	27,508	—	31,805	9,768,433	123,576,900

Arrears paid during the year and included in the total cost 42,365,148

Arrears due at end of year not included in the total... .. 623,434

APPENDIX E.

STATEMENT SHOWING THE NEW BANKS AND CHANNELS MADE IN 1902,
EXCLUSIVE OF "SPECIAL WORKS."

NAME OF WORK.	Length in kilometres.	Quantity of earthwork.	Total quantity.
		C.M.	C.M.
4TH CIRCLE.			
ASYUT PROVINCE.			
Diversion of Nile bank at Emariya... ..	0.792	19,321	
Joining up canal El Milk with the Ghezireh... ..	0.309	7,434	
Remodelling canal Ghezireh El Hawatha	0.318	8,079	
East Ghunabiyah to west of head reach of Sabakah Canal...	4.810	13,979	
			48,813
MINIA PROVINCE.			
Diversion of Nile Bank at Foshn	0.240	4,497	
Diversion of Nile Bank at Minia	0.176	3,090	
Diversion of Nile Bank at Samalut... ..	0.415	9,560	
Hawashat Gezireh El Sirariyah	0.316	4,236	
Salibah from Talt Bridge to corner of Old Salibah	0.240	6,301	
			27,684
BENI SUEF PROVINCE.			
Extension of Saharet El Magnuna Canal	1.800	8,020	
			8,020
Total 4th Circle ...	—	—	84,517
5TH CIRCLE.			
KENA PROVINCE.			
Extension of Sayalet Hod Esna south	2.630	12,696	
Extension of Sayalet El Adayma	2.186	7,919	
Approach channel Ritti Escape	1.936	8,552	
			29,167
ASWAN PROVINCE.			
Extension of Sayalet Sahil Ramadi... ..	5.725	55,064	
			55,064
Total 5th Circle ...	—	—	84,231
Carried over ...	—	—	168,748

STATEMENT SHOWING THE NEW BANKS AND CHANNELS MADE IN 1902,
EXCLUSIVE OF "SPECIAL WORKS"—continued.

NAME OF WORK.	Length in Kilometres.	Quantity of earthwork.	Total quantity.
		C.M.	C.M.
<i>Brought Forward</i> ...	—	—	168,748
GIRGA DIRECTORATE.			
GIRGA PROVINCE.			
Extension of Sayalet Hod Bardis East of Rashwaniyah ...	1491	3,890	17,756
Diversion of Nile tarrad of Hod Sahil Tukh... ..	9427	5,578	
Diversion of Nile tarrad Hod Moefin	9639	8,288	
ASYUT SOUTH.			
Diversions of Hassan Darwish Canal	9528	23,020	37,686
Sayalet Sahil El Badari	2314	14,656	
Total Girga Directorate ...	—	—	55,442
Grand Total... ..	—	—	224,190

ABSTRACT.

CIRCLE	New Channels.	New Banks.	Expenditure.
	Kilometres.	Kilometres.	£ E. M.D.
4th Circle... ..	7237	2179	1,126,729
5th Circle... ..	12477	—	997,000
Girga Directorate	4163	1126	893,512
Total...	23817	3305	3,017,241

APPENDIX F.

GENERAL ABSTRACT OF EXPENDITURE ON "SPECIAL WORKS" CHARGED TO SPECIAL CAISSE CREDIT AND SPECIAL GRANT FROM ORDINARY BUDGET.

NAME OF PROJECT.	NAME OF WORK.	EXPENDITURE				
		Ordinary Budget.	Caisse Credit.	Total per Work.	Total per Project.	Total per Circle.
	4TH CIRCLE.	£ E.	£ E.	£ E.	£ E.	£ E.
West of Yusef Project Minia Province.	Iron work Nezet El Abid and Saqula Regulators	322,756	—	322,756		
	Masonry works in Basins	254,178	3,690,250	3,944,428		
	Land	—	637,027	637,027		
	Rubble revetment,	—	18,624,024	18,624,024		
	Quarters for Staff and Magazines Nezet El Abid and Saqula, ..	888,111	—	888,111		
					19,432,671	
Mazurah Regulator and Lock.	Iron work	1,211,691	—	1,211,691		
	Rubble revetment	—	770,638	770,638		
	Quarters for Staff and Magazine ..	370,000	—	370,000		
	Land	—	95,711	95,711		
					2,477,940	
Extension of West Mohit Drain across Had Sultani.	Earthwork	—	2,663,750	2,663,750		
	Land	—	779,631	779,631		
	Masonry works	—	4,023,857	4,023,857		
					7,467,238	
Walidiyah syphon under Ibrahimieh Canal.	Walidiyah syphon under Ibrahimieh Canal	—	2,240,685	2,240,685		
					2,240,685	
	Magnum syphon, Beni Suof Province	—	218,796	—		
					218,796	
Remodelling Branches of Ibrahimieh Canal.	Earthwork	—	3,172,117	3,172,117		
	Masonry works	2,295,471	1,853,110	4,058,581		
	Rubble revetment	—	416,713	416,713		
					7,647,411	
Bani Khalid Canal and Hoshah Tanuh.	Earthwork	—	2,132,923	2,132,923		
	Masonry works	661,764	1,778,101	2,409,855		
					7,542,778	
Fayoum Remodelling Projects.	Establishment	—	2,594,269	2,594,269		
	Land for canals	—	5,004,403	5,004,403		
	Earthwork	—	40,242,670	40,242,670		
	Masonry works	2,799,173	14,068,080	17,458,253		
	Inspection Houses	570,000	—	570,000		
	Land required for Drains	—	200,000	200,000		
	Earth work in Drains	—	14,734,114	14,734,114		
	Masonry works in drains	600,000	5,402,607	6,002,607		
					87,291,766	
					131,294,462	
	Carried over ..	—	—	—	—	131,294,462

**GENERAL ABSTRACT OF EXPENDITURE ON "SPECIAL WORKS" CHARGED TO SPECIAL CAISSE
CREDIT AND SPECIAL GRANT FROM ORDINARY BUDGET (continued.)**

NAME OF PROJECT	NAME OF WORK.	EXPENDITURE.				
		Ordinary Budget.	Caisse Credit.	Total per Work.	Total per Project.	Total per Circle.
		£ E.	£ E.	£ E.	£ E.	£ E.
	<i>Brought Forward</i> ..	—	—	—	—	134,204.462
	PROJECTS CIRCLE.					
Conversion of Asyut Basins.	Strengthening canal Banks	—	8,699,788	8,699,788		
	Extending channels	421,682	2,477,981	2,899,663		
	Masonry works	191,395	11,080,914	11,272,309		
	Land	—	16,410,433	16,410,433		
	Irrigation outlets	—	1,725,425	1,725,425		
	Boundary stones	—	133,070	133,070		
	Working canals in flood and winter	724,054	229,598	953,654		
	Miscellaneous	—	56,800	56,800		
					42,150,472	
Conversion of Southern Minia Basins.	Earthwork	—	—	87,503,438		
	Masonry work	1,256,053	43,017,962	44,274,015		
	Land	—	4,639,209	4,639,209		
	Diversion of Bahr Yusef	—	—	545,794		
	Working canals	659,018	—	659,018		
	Inspection Houses	630,000	—	630,000		
	Irrigation outlets	—	2,340,000	2,340,000		
	Miscellaneous	—	257,823	257,823		
					140,849,297	
Etsa Pumping Station.	Pumping Plant	—	4,001,434	4,001,434		
	Masonry work	295,987	6,300,000	6,595,987		
	Labour for erection of Plant	—	47,760	47,760		
	Miscellaneous	89,495	112,436	201,931		
					10,847,112	
Widening Ibrahimieh Canal.	Earthwork	—	27,162,247	27,162,247		
	Masonry works	257,423	2,867,891	3,125,314		
	Rubble revetment	—	1,127,100	1,127,100		
	Land	—	2,428,209	2,428,209		
					33,842,570	
Remodelling Mohit Drain.	Earthwork	—	24,083,880	24,083,880		
	Masonry works	—	4,751,298	4,751,298		
	Land	—	558,724	558,724		
	Miscellaneous	—	287,406	287,406		
					29,681,308	
	Establishment and contingencies ..	361,078	12,890,279	13,251,357		
					13,251,357	
	5TH CIRCLE.					270,622,411
	<i>Arrears for 1901.</i>					
Hamad Escape.	Hamad Escape	—	189,061	189,061		
					189,061	
	GIRGA DIRECTORATE.					189,061
Taliah Regulator & contingent works.	Taliah Regulator and Contingent Works	—	12,999,471	12,999,471		
					12,999,471	
	Grand Total.. .. .	—	—	—	—	418,105,405

APPENDIX G.

LIST OF MASONRY WORKS EXECUTED UNDER "SPECIAL WORKS" GIVEN IN APPENDIX F.

NAME OF PROJECT.	NAME OF WORK.	COST.		
		Per Work.	Total per Project.	Total per Circle.
		£ E.	£ E.	£ E.
4TH CIRCLE.				
West of Yusufi Basins.	Iron work Nozlet El Abid Sagula Regulators.	322.756		
	Two-vent Regulator Zawyat Hafid	1,383.550		
	Two-vent Regulator Tokh Salihah	1,393.103		
	One-vent Regulator Salihah Qannadhr	1,283.770		
	Quarters for Staff and magazine Nozlet El Abid.	568.271		
	Quarters for Staff and magazine Sagula	320.170	5,171.620	
Mazurah Regulator and Lock.	Lift Bridge and erection of iron work	1,241.691		
	Quarters for Staff and magazine	370.000	1,611.691	
Extension of west Mohit Drain.	Drain syphon	2,854.900		
	Two road Bridges on Drain	1,168.948	4,023.847	
Walidiyah syphon on Ibrahimieh Canal.	Part Payment for Pipes	2,240.685	2,240.685	
	Final Payment	218.796	218.796	
Remodelling. Branch Canals of Ibrahimieh.	Regulating boards Walidigah Canal Head-slucice.	120.000		
	Masonry ends for Pipe sluice Canal El Milk...	70.000		
	Iron gates and traveller for Ibrahimieh Regulator at Deirat.	1,722.500		
	Eleven masonry works west Hafiz Gannabiyah.	1,910.110		
	East Hafiz Gannabiyah Head-slucice drainage culvert above Hafiz Regulator.	1,034.105		
	Deirutiya Gannabiyah Head sluice	72.100	4,658.815	
Bani Khalid Canal and Hoshah Tunah.	Bridge at head of Bani Khalid Canal.	796.951		
	Six-arch culvert	3,277.522		
	Feeder sluice Hoshah Tunah.	543.958		
	Regulator Salihah Hoshah Tunah.	792.024	5,409.855	
Bahr Nezieh and Branches Fayoum.	Tagit Aqueduct arrears	1,700.797		
	Eight small works 2nd reach Bahr Nezieh. ..	764.361		
	Eight culverts 2nd reach Bahr Nezieh.	471.153		
	Two falls Bahr Shulan	381.152		
	Twelve Masonry works Bahr Kasr-El-Banat ..	2,502.422	5,820.132	
Bahr Seilah and Branches Fayoum.	Railway Bridge Abdulla Wahbi Canal.	994.000		
	3 Road Bridges on Abdulla Wahbi Canal.	—		
	1 Regulator on Abdulla Wahbi Canal.	—		
	Head sluice 2nd Reach Bahr Seilah	—		
	Pipe aqueduct on Abdulla Wahbi Canal	—		
	Junction Fall 2nd reach Bahr Seilah.	—		
	2 Falls Abdulla Wahbi Canal.	—		
	8 Head Sluices Abdulla Wahbi Canal.	8,501.119	9,495.119	
	Carried over.	—	38,050,570	

LIST OF MASONRY WORKS EXECUTED UNDER "SPECIAL WORKS" GIVEN IN APPENDIX F.

NAME OF PROJECT	NAME OF WORK	COST.		
		Per Work.	Total per Project.	Total per Circle.
		E.E.	E.E.	E.E.
	<i>Brought forward..</i>	—	18,991.171	
Minor Projects Fayoum.	2 Small works Metastasis alani Project ..	203.347		
	(Government share of combined Road and Railway Bridges ..	1,451.790		
	At Barrage Aqueduct ..	200.000		
	Hawara Pipe-syphon ..	248.065		
	2 Inspection Houses part payment ..	570.000	2,718.392	
Drains in Fayoum.	Thirty three small works-tugla system ..	5,991.807		
	Two fella Masraf Shalalan ..	477.750	6,469.557	47,226.479
	PROJECTS CIRCLES			
Conversion of Asyut Basin.	12 Head sluices ..			
	3 Regulators ..			
	14 Escapes ..			
	3 Pipe-syphons ..			
	28 Drainage Inlets ..	11,272.897	11,272.899	
Conversion of southern Minia Basin.	17 Regulators ..			
	77 Head sluices ..			
	1 Fall ..			
	83 Head Bridges ..			
	12 Drainage inlets ..			
	5 Syphons ..			
	2 Escapes ..	44,234.015	44,234.015	
Elsa pumping station.	Masonry works in engine room & boiler-Houses.	6,895.987		
	Purchase and erection of Plant ..	1,251.125	10,847.112	
Widening Hershinish Canal.	Arrears for masonry works constructed in 1901.	2,477.072		
	Five road Bridges on Safsafah Canal retired to make room for widening Hershinish Canal ..	440.897		
	Lengthening 6 timber bridges on Hershinish Canal ..	205.065	3,123.314	
Remodelling Mohit Dam.	8 Older Bridges on masonry abutments and piers ..	4,751.993	4,751.993	74,230.073
	GIRGA DIRECTORATE.			
Tallhat Regulator.	Completion of Tallhat Regulator ..	12,999.171	12,999.171	12,999.171
	5TH CIRCLE.			
Hamed Escape.	Arrears for Hamed Escape ..	189.091	189.091	189.091
	Grand Total ..			
		—	—	134,648.684

APPENDIX H.

LIST OF NEW AND REMODELLED BANKS AND CHANNELS EXECUTED UNDER
"SPECIAL WORKS" GIVEN IN APPENDIX F.

NAME OF PROJECT.	NAME OF WORK.	Length in kilometres.	Quantity of Earthwork.	Cost.	
				Per work.	Total per Project.
			C.M.	£ F.	£ E.
4TH CIRCLE.					
Mohit drain extension	Earthwork in Mohit drain	1.600	201,500	2,063,750	2,063,750
Branch of drains Horchimish.	West Hailz Ghannabiyah and Branches	23.480	180,328	2,683,505	3,172,317
	Dairatiyah Ghannabiyah south of Salakhah Canal	7.000	39,089	488,612	
Bani Khalid Canal and Hoshah Tunah.	Bani Khalid Canal	3.015	102,602	1,602,088	2,182,023
	Salihah Hoshah Tunah	2.888	33,815	439,985	
Bahr Nezieh and Branches Fayoum.	Remodelling 2nd reach Bahr Nezieh	20.000	388,363	380,290	3,678,622
	3rd reach Bahr Kaez El Banat	8.000	127,700	2,297,632	
Bahr Seilah and Branches Fayoum.	Remodelling 1st reach Bahr Seilah	5.700	374,117	8,383,060	36,366,501
	1st reach Abdolla Wahby Canal	13.800	742,578	15,401,630	
	2nd reach Abdolla Wahby Canal	9.000	310,444	12,481,695	
Minor Projects Fayoum.	Remodelling Bahr Metartarisim	6.800	10,854	297,517	297,517
Drains Fayoum.	Remodelling Tagin drains	100.400	513,040	11,605,315	14,704,144
	Remodelling Tagin drains Masraf Abu Awad	3.300	103,375	815,562	
	Constructing Masraf Shaudan	25.000	140,198	2,813,267	
Conversion of Asyut Basins.	Distributaries	25,500	210,841	2,800,000	11,506,651
	Drains	0,500		—	
	Strengthening Banks of Distributaries	—	740,110	8,009,488	
Conversion of southern Mida Basins.	Canals and Distributaries	200.000	5,305,049	72,581,770	88,012,287
	Drains	208.000	304,311	7,221,618	
	Bahr Yusuf Diversion	—	10,847	568,849	
	<i>Grand total</i>	770,708	10,108,483	162,556,744	162,556,752

LIST OF NEW AND REMODELLED BANKS AND CHANNELS EXECUTED UNDER
"SPECIAL WORKS" GIVEN IN APPENDIX F. (cont.)

NAME OF PROJECT.	NAME OF WORK.	Length in kilometres.	Quantity of Earthwork.	COST.	
				Per work.	Total per Project.
			C.M.	£ E.	£ E.
Widening Berahinnich Canal.	<i>Brought Forward</i>	779,798	19,108,483	162,556,744	162,556,752
	In reach between Minan and Etsa.	—	202,052	5,253,863	
	In reach between Etsa and Abu Isa Head,	21,500	1,085,676	18,542,066	
	New tail reach for Tafwda Canal between Etsa and Abu Isa Head	15,000	143,280	2,292,480	26,088,809
Remodelling Mohai Drain.	Earthwork from Sabakhah Canal to Etsa	90,000	1,476,954	24,083,880	24,083,880
	Total Channels, Banks and drains Pro- posed Circle	855,798	2,732,823	149,783,827	149,783,827
	Grand Totals	855,798	13,999,842	—	212,729,431

ABSTRACT.

	KILOMETRES.
New Irrigation channels	407,910
Remodelled channels	53,500
New Drains	238,800
Remodelled drains	152,700
New Banks	2,880
Total	<u>855,798</u>

APPENDIX K.

REVTMENT OF BASIN BANKS WITH STONE.

PROVINCE.	LENGTH REVTED.			EXPENDITURE DURING THE YEAR.		
	Previously Reported.	Added during 1902.	Total to date.	New Revtment.	Repairs.	Total Expenditure.
	M.	M.	M.	£ E.	£ E.	£ E.
4TH CIRCLE.						
Asyut North... ..	54,127	5,109	59,236	2,658	62	2,720
Minia	58,063	31,006	89,069	13,270	—	13,239
Beni Suef,	36,156	4,173	40,329	1,826	—	1,826
Total...	148,346	40,288	188,634	17,723	62	(a) 17,785
5TH CIRCLE.						
Aswan	—	—	—	—	—	—
Kenn.	65,231	979	66,210	618	—	618
Total...	65,231	979	66,210	618	—	618
GIRGA DIRECTORATE.						
Girga	46,159	1,094	47,253	882	249	1,131
Asyut South... ..	46,929	3,274	50,203	1,300	51	1,351
Total...	93,088	4,368	97,456	2,182	300	2,482
Grand Total...	306,665	45,635	352,300	20,523	362	20,885

(a) Special Works Credit.	£.E.14,811.273
Preliminary Budget	" 2,973.725
Total... ..	<u>£.E.17,785.000</u>

APPENDIX L.

STATEMENT SHOWING T.R. LEVELS, MAXIMUM LEVELS ATTAINED DURING THE FLOOD OF 1902, AND ESTIMATED SHARAKI AREAS IN THE BASINS OF UPPER EGYPT.—*continued.*

NAME OF SYSTEM.	NAME OF BASIN.	T. R. Level.	Maximum Level attained during flood of 1902.	Difference.	Estimated Sharaki Area.	TOTAL.
Aswan Isolated Basins.	Khattam	92.00	80.82	2.08	350	5.885
	Damw	90.75	88.00	1.75	1.400	
	Bimban	90.00	88.00	1.00	8.00	
	Egit	89.15	87.24	1.91	500	
	Hadisayah	85.70	84.14	1.56	3.005	
Hamadi	Ramadi South	86.75	84.78	1.97	100	4.225
	Ramadi North	85.70	84.24	1.46	2.100	
	Edfu	85.30	84.01	1.29	1.200	
	Sihay	82.00	82.12	0.12	200	
	Noman	82.30	81.31	0.99	200	
	Isma South	81.45	81.07	0.38	—	
	Isma North	81.00	80.46	0.54	—	
	Aafon	79.00	79.46	0.46	100	
Aafon	El Kham	79.57	79.25	0.32	20	1.000
	El Mahamid	79.00	78.30	0.70	50	
	El Reifi	78.50	77.64	0.86	100	
	El Makhar	77.85	77.00	0.85	—	
Fadiliyah	Badiya	77.10	76.00	1.01	1.500	2.665
	Qamha	76.45	75.48	0.97	50	
	El Ahlous	76.65	75.60	1.05	700	
	El Hayyan	76.25	75.48	0.77	40	
	Dancqua East	75.80	74.84	0.96	1.225	
	Dancqua West	75.85	74.72	1.13	100	
	El Kattara	75.10	74.60	0.50	100	
	Tukh	75.00	74.48	0.52	—	
	Zawaidah West	74.30	73.91	0.39	—	
	Alm Ghaz	75.00	74.28	0.72	—	
	Ballas and Dahr	74.10	73.61	0.49	—	
	El Towerat	73.30	73.24	0.06	—	
	Zawaidah East	74.50	73.30	1.11	300	
	El Taransa	72.95	72.32	0.63	—	
	Dancqua	72.60	72.05	0.55	150	
Sahel Farahut	El Mareshda	71.10	70.62	0.48	30	12.500
	El Waki	70.50	70.26	0.24	20	
	West Rantman	70.95	69.63	1.32	250	
	Haw	69.80	68.58	1.22	2.225	
	El Qumman	68.00	67.50	0.50	—	
	El Dahman East	67.60	66.91	0.69	—	
	El Dahman West	67.00	66.50	0.50	—	
	Bakharis	67.20	66.74	0.46	—	
	Kom El Almar	66.75	66.39	0.36	—	
	Sambud	66.50	64.93	1.57	6.500	
	El Raquique South	67.00	65.02	0.98	50	
	El Raquique North	66.75	65.60	1.15	1.000	
	Sahara East	67.50	66.20	1.30	1.125	
	Sahara West	67.00	65.86	1.14	1.000	
	Channel over	—	—	—	—	27.050

STATEMENT SHOWING T. R. LEVELS, MAXIMUM LEVELS ATTAINED DURING THE FLOOD OF 1902,
AND ESTIMATED SHARAKI AREAS IN THE BASINS OF UPPER EGYPT.—*continued.*

NAME OF SYSTEM.	NAME OF BASIN.	T. R. Level.	Maximum Level attained during flood of 1902.	Difference.	Sharaki Area.	TOTAL.
	<i>Brought forward</i>	—	—	—	—	27°050
Killahyah	El Der	81°85	—	—	—	2°085
	Salamiyah { South	78°90	78°60	0°30	2°085	
	{ North	78°70	77°80	0°81	17	
Baryaslyah	El Gabbasa	78°30	77°00	1°24	160	6°850
	El Hadda { East	78°15	76°92	1°23	180	
	{ West	77°00	77°06	0°84	240	
	El Korink { East	77°45	76°00	1°05	250	
	{ West	77°10	76°03	0°77	250	
	El Ashi { East	76°00	75°35	1°35	500	
	{ West	77°00	76°56	1°44	2°800	
	Dammil	76°25	75°05	1°20	1°000	
	Higana	75°00	74°08	0°52	100	
Shanhuriyah	Ennash { South	75°70	75°00	0°70	150	4°350
	{ North	75°35	74°00	0°75	250	
	Qift East { East	75°30	73°75	1°35	2°400	
	{ West	75°15	73°72	1°13	000	
	Bennad	74°10	73°42	0°38	150	
Ghifas	El Geddulow	73°70	72°85	0°85	—	12°420
	El Mahdama	73°50	72°70	0°80	1°200	
	El Kenuwiyah	72°30	72°35	—	—	
	Awlad Awad	72°50	72°08	0°42	150	
	El Tawadly	72°20	71°60	0°56	20	
	Abu Huh	71°80	71°00	0°75	50	
	Sarata	71°30	70°50	1°11	1°200	
	Ginnasah	71°30	70°78	0°52	2°100	
Kilyam	Hahna	71°00	70°32	0°68	3°200	1°230
	Hamed	70°00	69°44	1°46	2°100	
	El Hahna	69°10	67°22	1°18	200	
	Hod Batabish	67°15	66°50	0°56	—	
	Hod El Kilyam	67°00	66°05	0°55	—	
Akhum	Hod Hammam West of Hawa	66°20	65°55	0°65	—	1°230
	Canal	65°20	65°28	0°70	—	
	Hod Menata	65°20	64°22	0°58	—	
	Hod Awlad Yehia	65°20	64°22	0°58	—	
	Hod Hammam East of Hawa	66°20	65°50	0°31	—	
.. ..	Canal	62°20	61°14	1°06	—	1°150
	Hod Ashmim	61°20	60°53	0°67	—	
	Hod Sawman	61°20	60°09	0°51	—	
	Hod Saquta	61°10	60°31	0°79	—	
	Hod Kithaha West of Isawiya	60°35	59°82	0°53	—	
	Canal	60°45	59°68	0°72	—	
	Hod Isawiya	59°40	59°19	0°41	—	
	<i>Carried over</i>	—	—	—	—	55,185

STATEMENT SHOWING T.R. LEVELS, MAXIMUM LEVELS ATTAINED DURING THE FLOOD OF 1902,
AND ESTIMATED SHARAKI AREAS IN THE BASINS OF UPPER EGYPT.

NAME OF SYSTEM.	NAME OF BASIN.	T. R. LEVEL.	Maximum Level attained during flood of 1902.	Difference.	Estimated Sharaki Areas.	TOTAL.
	<i>Brought forward</i>	—	—	—	—	55*135
Khisindariyah	Hod El Nawnwa West ..	58*00	57*93	0*07		
	Hod El Nawnwa East ..	58*00	58*95	—		
	Hod Qaw West	57*16	57*21	—		
	Hod Qaw East	57*16	57*07	0*03		
	Hod El Aqal West ..	57*10	56*91	0*19		
	Hod El Aqal East ..	56*70	56*68	0*02		
	Hod El Dindari West ..	56*20	56*01	0*19		
	Hod El Dindari East ..	56*20	55*70	0*41		
	Hod El Sahil	55*40	55*04	—		
	Hoshah Sahil	55*80	55*12	0*68		
Abnub	Hoshah Enan	54*80	54*47	0*33		
	Hoshah Brest Gharnah ..	53*65	53*65	—		
	Hod El Gernit	54*40	53*74	0*66	102	102
	Hod El Mamas	53*00	52*56	0*44		
	Hoshah El Hammam ..	52*85	52*50	0*35		
	Hod El Hammam	51*50	50*90	0*60		
	Hod Beni Muir	52*20	52*07	0*13		
	Hod El Garhich	52*00	51*86	0*14		
	Hoshah Twanbiyah ..	51*00	51*35	0*65		
	Hod El Sawalin	51*25	50*59	0*66		
South Sohag System ..	Hod Beni Mohammed ..	50*50	50*45	0*05		
	Hoshah Saqalquill ..	50*00	50*00	—		
	Hod El Matabda	50*40	50*06	0*34		
	Hoshah Matabda	49*80	49*61	0*19	15	45
	Hod Beni Himel West ..	65*70	64*84	0*86		
	Hod Bardis West of Nasma Canal ..	66*40	65*52	0*88		
	Hod Bardis East of Nasma Canal ..	65*25	65*75	1*50		
	Hod Bardis East of Rashwandyah ..	65*15	63*76	1*39		
	Hod Agat	65*45	64*65	0*80		
	Hod Agat	65*70	64*68	1*02		
South Sohag System ..	Hod Khulafa	64*75	64*16	0*59		
	Hod Birta East of Kasma Canal ..	64*00	63*61	0*39		
	Hoshah Birta West	63*83	63*75	0*08		
	Hoshah Birta	64*30	64*22	0*08		
	Hod Gin Khulafin	64*87	64*75	0*12		
	Hod Himedi	64*50	64*16	0*34		
	Hod Rayyadi	64*70	64*07	0*63		
	Hoshah Assirat	64*15	63*60	0*55		
	Hod Araba West	63*70	63*24	0*46		
	Hod Araba East	63*80	62*23	0*57		
South Sohag System ..	Hod Mitr West	63*85	63*30	0*55		
	Hod Mitr East	63*85	63*33	0*50		
	Hod Sakil Fakh	64*10	63*49	0*61		
	Hoshah Kawani	62*80	62*47	0*33		
	Hod Sahiya and Kharifa ..	63*00	63*25	0*25		
	Hod Sahiya and Bawark ..	63*40	62*99	0*41		
	Hod Kasani and Harizat ..	62*80	62*48	0*32		
	Hod Minshah West	63*15	62*43	0*72		
	Hod Minshah East	63*10	62*26	0*81		
	Hod Gin El Munassir	63*10	62*45	0*65		
South Sohag System ..	Hoshah Bahafura	62*60	62*19	0*41		
	Hod Sohag East	62*50	62*06	0*44		
South Sohag System ..	Hod Sohag West	62*50	61*80	0*70		
	<i>Canceled page</i>	—	—	—	1*293	1*293
						56*576

STATEMENT SHOWING T. R. LEVELS, MAXIMUM LEVELS ATTAINED DURING THE FLOOD OF 1902,
AND ESTIMATED SHARAKI AREAS IN THE BASINS OF UPPER EGYPT—concluded.

NAME OF SYSTEM.	NAME OF BASIN.	T. R. Level.	Maximum Level attained during flood of 1902	Difference.	Estimated Sharaki Area.	TOTAL.
	<i>Brought forward</i>	—	—	—	—	56·575
North Sobag System ..	Hod Araba Idfa	61·30	61·09	0·21		
	Hod Ghazirat	60·00	59·75	0·25		
	Hoshu Araba Idfa	61·25	61·19	0·06		
	Hod Masfin	61·25	60·39	0·86		
	Hod Nag Tamman	61·00	60·74	0·26		
	Hod Samarna	60·35	61·01	0·66		
	Hoshah Samarna	59·50	59·31	0·19		
	Hod Bannaweit	59·50	58·89	0·61		
	Hoshah Goheta	59·25	58·31	0·94		
	Hoshah Nazza	58·50	58·30	0·20		
	Hod Elnebis	59·10	58·64	0·46		
	Hoshah Nag Tamman	60·50	60·00	0·50		
	Hod Beni Hilal	59·59	59·05	0·54		
	Hod Sawamda El Garf	59·00	58·51	0·49		
	Hod Banahû	58·59	58·36	0·23		
	Hod Banga	58·40	58·06	0·34		
	Hoshah Sheikh Zein El Din	58·49	57·84	0·65		
	Hod Kom Badr | East	58·00	57·70	0·30		
	| West	58·20	57·68	0·52		
	Hod Om Dama | West	57·00	56·88	0·12		
	| East	57·10	56·77	0·33		
	Hod Madmar West	57·40	57·25	0·15		
	Hoshah Arab Bakhwag	57·70	57·58	0·12		
	Hod Shattara	58·10	57·87	0·23		
	Hod Miehla	57·00	57·41	0·41		
	Hod Whadmar East	57·60	57·14	0·46		
	Hod Naw El Garb	57·49	56·81	0·68		
	Hoshah Giz Timn	56·80	56·75	0·05		
	Hod Timn East	57·10	56·80	0·30		
ASYUT.						
2ND SECTION.						
	Hod Dower | West	56·20	56·01	0·19		
	| East	56·20	56·13	0·07		
	Hod Beni Sauri | West	55·40	55·25	0·15		
	| East	55·50	55·36	0·14		
	Hoshah Mgria	55·80	55·34	0·46		
	Hod El Zinnar	55·60	55·61	—		
					805	57·380

APPENDIX M.

STATEMENT SHOWING THE AREA UNDER DIFFERENT CROPS IN THE PROVINCES, UPPER EGYPT, INCLUDING GOVERNMENT AND WAKF'S LAND AND LAND OF THE DAIRA SANIER AND DOMAINS, FROM THE COMMENCEMENT OF THE FLOOD OF 1901 TO THAT OF 1902.

NAME OF PROVINCE.	Winter Crops.				Summer Crops.				Said Crops.		Total area of crops.	Waste land "Bara".	Total or mixed.	Area double cropped.	Area of cultivated land.
	Wheat.	Barley.	Other Crops.	Summer Maize.	Cotton.	Sugar Cane.	Other Crops.	Natural Maize.	Said Maize.	Said Beans.					
	FEDE.	FEDE.	FEDE.	FEDE.	FEDE.	FEDE.	FEDE.	FEDE.	FEDE.	FEDE.	FEDE.	FEDE.	FEDE.	FEDE.	FEDE.
Bahia Sud	235	81,560	66,925	20,659	42,740	—	8,023	24,746	4,344	1,516	285,033	3,512	285,546	42,675	222,870
Payum	2,866	71,972	26,364	28,929	87,207	—	637	40,725	761	3,109	470,721	82,965	557,686	292,402	256,284
Minia	577	90,167	92,660	90,427	90,366	—	12,157	24,117	34,598	2,616	661,319	26,381	686,660	70,641	115,019
Aghia	1,090	125,834	125,266	10,140	110,901	—	38,869	2,625	13,921	2,180	470,669	10,718	480,274	51,429	406,465
Giza	1,466	90,000	61,027	20,025	105,417	—	53,933	22	5,635	6,709	384,020	1,861	385,781	54,778	352,003
Kena	1,113	92,707	41,942	64,390	116,652	—	25,319	—	17,475	2,716	424,491	70,869	495,229	70,754	364,476
Assua	1,420	14,000	4,897	10,598	15,119	—	9,864	—	276	1,696	60,801	2,673	64,505	6,203	78,051
Total.. ..	9,793	594,014	467,972	202,960	572,770	—	116,548	90,263	80,660	19,636	94,061	143,418	2,729,111	361,673	2,226,437

Winter Crops.	1,867,960
Summer Crops.	313,192
Said Crops.	493,824
Barley.	3,783
Total.. ..	2,681,000

APPENDIX S.

TABLE I.—STATEMENT SHOWING THE QUANTITY OF SUGAR-CANE CRUSHED IN THE DAIRA SANIEH FACTORIES IN MIDDLE AND UPPER EGYPT IN SEASON 1901-1902 AND THE AMOUNT OF No. 1 SUGAR PRODUCED.

NAME OF FACTORY.	Cane crushed in kantars.	Outturn of No. 1 Sugar in kantars.
MIDDLE EGYPT.		
Bibu	1,924,905	179,102
Maghagha	"	"
Matai	1,693,594	153,117
Minia	2,185,032	192,222
Abu Qirquas,	1,223,337	111,469
Roda	2,112,692	203,773
Total, Middle Egypt	9,139,560	839,683
UPPER EGYPT.		
Dabaiyah	801,698	72,646
Armunt	469,480	41,470
Mata'annah	732,753	74,306
Total, Upper Egypt	2,003,931	188,422
Grand Total	11,143,491	1,028,105

APPENDIX S—*continued.*

TABLE II.—SUGAR-CANE CRUSHED AND SUGAR OUT-TURNED BY THE DAIRA SANIER FACTORIES DURING THE LAST TWENTY-FOUR YEARS.

Factory season.	From crop of	Quantity of cane crushed in kantars.	Total sugar produced in kantars.	Nature of summer level preceding factory season.	REMARKS.
1880	1879	8,402,833	605,623		The total sugar produced includes the three qualities Nos. 1, 2 and 3.
1881	1880	2,365,642	182,096		
1882	1881	7,336,192	603,225		
1883	1882	4,880,004	422,622	Unfavourable.	
1884	1883	8,445,247	667,451	Favourable.	
1885	1884	9,918,201	854,884	Very favourable.	
1886	1885	11,258,057	973,500	Fair.	
1887	1886	10,986,224	934,376	Favourable.	
1888	1887	10,411,640	961,352	Favourable.	
1889	1888	8,382,837	790,197	Fair.	
1890	1889	7,602,302	695,870	Very favourable.	
1891	1890	11,130,799	1,149,893	Very low.	
1892	1891	12,522,918	1,329,627	Low but early rise.	
1893	1892	12,755,107	1,207,164	Low and late rise.	
1894	1893	14,253,813	1,427,608	Very favourable.	
1895	1894	14,601,832	1,385,345	Favourable.	
1896	1895	15,217,050	1,564,972	Very favourable.	
1897	1896	13,253,433	1,882,979	Very favourable.	
1898	1897	12,369,140	1,176,067	Very favourable.	
1899	1898	11,636,689	1,173,871	Low.	
1900	1899	12,680,860	1,340,983	Very favourable.	
1901	1900	9,680,482	1,057,902	Very low but early rise.	
1902	1901	9,649,009	1,081,967	Very low rise early, but feeble.	
1903	1902	9,144,560	* 944,643	Very low with late and feeble rise.	

*This is calculated from No. 1 Sugar produced by adding one-eighth to allow for Nos. 2 and 3 Sugar:—

	Kantars.
Thus No. 1 Sugar	839,683
Nos. 2 and 3 Sugar	104,960
Total... ..	<u>944,643</u>

NOTE : — The above only includes the Middle Egypt factories which crush cane irrigated by the Ibrahimieh Canal.

APPENDIX S—*continued.*

TABLE III.—SUGAR-CANE CRUSHED AND SUGAR OBTAINED IN SULTAN PASHA'S FACTORY AT DAMARIS DURING THE LAST TWENTY YEARS.

Factory Season.	From crop of	Quantity of cane crushed in kantars.	Total sugar produced in kantars.	REMARKS.
1884	1883	258,855	23,199	The total sugar produced includes the three qualities Nos. 1, 2, and 3.
1885	1884	258,405	24,720	
1886	1885	250,426	23,705	
1887	1886	272,984	23,903	
1888	1887	274,549	23,636	
1889	1888	276,505	24,648	
1890	1889	266,218	23,783	
1891	1890	228,421	31,609	
1892	1891	382,791	36,161	
1893	1892	442,187	37,275	
1894	1893	471,076	40,253	
1895	1894	545,274	47,429	
1896	1895	541,202	51,954	
1897	1896	587,462	59,543	
1898	1897	451,390	40,566	
1899	1898	479,822	48,761	
1900	1899	466,027	46,732	
1901	1900	524,466	54,966	
1902	1901	410,465	44,700	
1903	1902	565,934	*52,102	

*This is calculated from No. 1 Sugar produced by adding one-ninth to allow for Nos. 2 and 3 Sugar.

APPENDIX S—concluded.

TABLE IV.—STATEMENT SHOWING THE QUANTITY OF SUGAR-CANE CRUSHED IN THE FACTORIES OF THE
 “SOCIÉTÉ GÉNÉRALE DES SUCRERIES DE LA HAUTE-ÉGYPTÉ” AND THE QUANTITY OF NO. 1 SUGAR
 PRODUCED DURING THE PAST SIX YEARS.

SEASON.	FACTORIES.					TOTAL.		
	Nagin Hatmadi.		Shokh-Pauli.		Hawmillyah.		Cane crushed in kilnars.	Outturn of No. 1 sugar in kantar.
	Cane crushed in kilnars.	Outturn of No. 1 sugar in kantar.	Cane crushed in kilnars.	Outturn of No. 1 sugar in kantar.	Cane crushed in kilnars.	Outturn of No. 1 sugar in kantar.		
1896-1897	644,438	68,888	1,822,204	191,109	1,333,320	135,554	3,709,902	395,551
1897-1898	1,561,418	108,870	2,782,670	238,574	654,808	56,990	5,008,896	409,434
1898-1899	1,776,825	173,263	3,158,415	304,949	1,315,080	125,790	6,250,320	504,002
1899-1900	1,618,341	168,252	3,169,252	301,191	1,191,278	105,641	5,978,871	575,409
1900-1901	—	—	—	—	—	—	6,908,772	682,587
1901-1902	3,231,460	267,000	3,505,617	283,164	916,471	94,067	7,653,548	* 642,813
1902-1903	3,233,284	315,977	3,487,123	371,570	923,092	108,038	7,644,099	795,585
	83,480		182,289		94,559		360,688	

ADMINISTRATION REPORT
OF THE
IRRIGATION DEPARTMENT IN LOWER EGYPT
For 1902

BY
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ADMINISTRATION REPORT OF THE IRRIGATION DEPARTMENT IN LOWER EGYPT FOR 1902.

CHAPTER I.

WINTER, SPRING AND SUMMER IRRIGATION.

For the third year in succession the winter levels of the Nile were so bad that a coming summer of low discharges could be confidently predicted. But there was enough water in the river in February to provide for the heavy irrigation of winter crops which then takes place, and also for the first sowings of cotton. Profiting by the experience gained in former seasons, the river levels above the Barrage were raised by regulation during February, in anticipation of the demand, to the height necessary to give such discharges to the canals as would satisfy everybody.

As was noted in last year's Report, p. 162, the strain experienced after the middle of June, in 1901, was sufficient to demonstrate that the available supply at that time was not ample enough to give a watering to all the standing crops in twenty-one days; but that it would have made the programme work more smoothly, if the intervals between waterings had been lengthened so as to have allowed twenty-four days instead of twenty-one for giving a single watering to all the summer crops. Such being the lesson of 1901 and seeing that the prospect of 1902 was worse than that of 1900, it was decided to adopt 24 days as the extreme period between waterings. The rotation programmes were accordingly drawn up allowing for one watering in 21 days from 5th May up to the 8th June and in 24 days after 8th June until 18th July. From 19th July the period between waterings was shortened to 15 days by overlapping the periods of working of the different sections, of which there were three. The period of working for each section was invariably 7 days, the intervals of stoppage between the working periods varying as the relation between supply and demand varied.

It seems to be a not uncommon error to suppose that the Irrigation Officers do not know that the crops require a greater abundance of water in late June and early July than at other times. The rotation programmes no doubt give rise to this belief, as up to 9th June waterings at shorter intervals are allowed than afterwards. But this is a necessity that is forced upon us, and not the result of choice. The interval between waterings is regulated by the facts of the situation, being determined by the extent of the area of crop to be watered and the amount of water that is available for watering it. Experience has shown that, during June and half July or such years as 1902, it takes 24 days to irrigate the whole area of summer crop with the total available supply that can be got out of the river. If, under such conditions of supply, the period were to be shortened to 21 days for instance, the result would be that one eighth of the standing crop would perish for want of irrigation. The question is one of simple arithmetic; but many intelligent cultivators are too anxious for another solution to accept the correct and, to unprejudiced people, obvious one. With a given area of crop, more frequent waterings necessitate a more abundant supply of water; with a given supply of water more frequent waterings cannot be given without a decrease in the area of crop watered.

The general desire among cultivators appears to be that the period between waterings should be 15 days. If one watering is given in 15 days (assuming that an equal quantity of water is used for each watering in a one-in-fifteen days as in a one-in-twenty-one days rotation) the area of crop watered would be about 30 per cent less than could be watered with a one-in-twenty-one days rotation. Moreover 5 days is too short a time to allow for the working turn of each of the three sections. Probably the most convenient rotation period to adopt will be 18 days, divided up into 3 working periods of 6 days each. If, with such a programme, it is found that it is not possible to give a single watering to all the crops in 18 days, one day or two days general stoppage can be inserted between each of the 6-day normal periods of working, and so the period for watering the whole area can be increased to 21 or 24 days according to necessity. These general days' stoppage would be utilised to fill channels from which the next section was about to irrigate, and to give water to lands which it had not been found possible to irrigate in their proper turn.

It is, however, probably true that, if the intervals between waterings are shortened, not quite so much water is used for each single watering as would be the case with lengthened intervals.

The foregoing remarks apply to cotton crops only. As was the case in 1901, it was realised early in the year that the river supply in summer would undoubtedly be insufficient to permit of the unrestricted cultivation of Sultani rice. Consequently the same policy was adopted as the year before, namely, to arrange for rice cultivation on those canals on which such provision could be made without interfering in a serious manner with the general programme for cotton, which allowed one watering in 21 and 24 days. The arrangement made for rice was 5 days supply and 6 days non-supply alternating. In the 2nd and 3rd Circles the tracts chosen for giving rice-growing facilities were the same as the year before, viz: the Bahr Saidi and north branches, and the Mahmudia and Rosetta Canals. In the 1st Circle the canals thus treated were the Saidia Canal from Abu Shalabi to the tail, Mustagadda Canal and branches, and Singaha East and West branches; and also the Tanah and Gabbada canals.

The rotation programmes, as drawn up early in 1902 (in March), were applied without modification; except that in the 1st and 2nd Circles the first application was postponed till 19th May, the 3rd Circle abiding by 5th May as originally fixed. The practical working of the programmes showed that they were exactly suited to the conditions of water supply existing in the summer of 1902. "Summer Rotations" ceased in the 1st Circle on 10th August, in the 2nd Circle on 1st September, and, in the 3rd Circle, on 12th August in S. Behera and 19th August on the Mahmudia.

The "Sharaki" Decree, forbidding the inundation of lands for the sowing of fallow fields until such time as the Minister of Public Works should decide, was issued on 4th April, but by error was not made applicable to engines and pumps lifting water from the two branches of the Nile. This error was corrected by the issue of another Decree on 8th May, by which the prohibition was made applicable also to river pumps below the Delta Barrage. The enforcement of this Decree did not commence until 26th May. The prohibition was removed generally on 19th July, but along certain canals on 11th July. Those canals were the Rosetta Canal in the Behera Province, and the Bahr Saidi and its northern branches in the Gharbia Province. The possibility of fixing an earlier date for these canals was a consequence of the facilities for irrigation afforded by storing water in the trough of the river above the Mehallet-el-Emir Dam.

MEHALLET-EL-EMIR DAM.

The Mehallet-el-Emir Dam was made in the usual place on the Rosetta Branch, but it was designed to hold up the water in the reservoir above it to twenty-five centimetres greater height than the year before, and half a metre higher than in 1900 and previous years. The crest level of the dam was fixed at R. L. 3·50 to provide for a H. W. L. in the reservoir of R. L. 2·50 (R. L. 2·47 was actually reached). The width of crest was 2 metres and the side slopes 3 to 1, giving a bank width at H. W. L. of 8 metres. For about 3 months this dam held up nearly two metres of water, and throughout the summer provided a continuous free-flow supply to the Bahr Saidi and the canals to the north of it, and also to the Rosetta Canal on the opposite side of the river. The Atfeh pumps, whenever necessary between 2nd July and 6th August, also pumped water from this reservoir to keep up the level of the Mahmudia Canal. It was on account of the presence of this stored water that rice-growing was encouraged on the canals fed with it, a high level in the reservoir being maintained by the additions due to infiltration and springs along the river bed above it.

From the middle of April to the end of the first week in August, there was drawn off from this pool by the 2nd Circle 47 million cubic metres of water and by the 3rd Circle 56 millions; or altogether 103 millions; that is, an average of a little over 900 cubic metres a day.

The Mehallet-el-Emir Dam cost to make, maintain and remove, L.E. 9644. It was begun on 15th January, closed on 27th March and completed by 2nd May. The construction was undertaken in the interests of irrigation, but navigation between Alexandria and Cairo also felt the benefit of its effects.

FARESKUR DAM.

The temporary dam near the tail of the Damietta branch was made at a new site in 1902. Hitherto it had been made a little to the north of Damietta town. But this position was unfavourable for the reasons given in last year's Report, and a new site was selected higher up the river a little below Fareskur. The result was fairly satisfactory, but the springs and infiltration on this branch do not provide a sufficient supply to keep the river pumps going. The sadd was given the same cross section as the Mehallet-el-Emir Sadd on the Rosetta branch. The H. W. L. provided for was R. L. 1·50, but actually R. L. 1·42 was the

maximum reached, and that was maintained for 4 days only from the 11th June. This level was obtained by passing a discharge from the Mansuria Canal into the river through the sluices of the lock at Mansura during May and early June, and allowing a small discharge also to pass the Delta Barrage.

The Fareskur dam was closed on 26th March. It cost to make, maintain and remove L.E. 5000, inclusive of a sum of L.E. 437 to be paid for land in 1903. The dam at the time of the maximum water level was holding up 2·10 metres of water. After the middle of June the Mansuria Canal could not spare any water to maintain the level of the reservoir; and the effect of the pumps and evaporation caused the reservoir level to fall at the rate of 4 centimetres a day. As the river above the Delta Barrage had risen by the 12th July, and as it seemed probable that difficulties would arise with the river pumps if the continuous fall of the Damietta Branch was not arrested, a million cubic metres a day was on that date started down the branch from the Barrage, and a second million added on the 19th July, as the first million produced but little effect. The fall at the dam was arrested on the 27th July, just as the condition of things was becoming critical; after that date the rise began and all difficulties quickly vanished. The lowest level to which the reservoir fell was R.L. 0·52 (27th July), which is only eight centimetres above sea level. The depth of stored water, therefore, utilised was 2 metres at the dam. A fall of four centimetres a day, when the reservoir was at its highest, would signify that the pumps and evaporation accounted for about 300,000 c.m. a day more than the springs and infiltration in the river-bed contributed. Some years ago it was calculated that the engines on this branch lifted about 2 million cubic metres a day. The springs and infiltration may therefore be credited with a discharge of about $1\frac{1}{2}$ million c.m. a day. The total quantity of water stored above the dam in the middle of June was probably from 12 to 15* million cubic metres; which quantity, if used up in a period of 50 days, would suffice for the irrigation of about 10,000 feddans of cotton or half that area of rice. It would seem, therefore, to be worth while to make this saddle in years when there is a probability of a scanty summer supply, with the object of storing water for the 50 critical days of summer, even were this the only advantage to be gained. But there is also to be obtained from it the further advantage of being able to use all the spring water which rises in the river bed above the dam: for it prevents the water being contaminated by an

* Mr. Langley calculates it was more than double this amount.

invasion of salt water from the sea, whereby it would, at any rate in the lower reaches, be rendered unfit for irrigation purposes. Unfortunately, too many pumps have been allowed on the Damietta Branch. If only half the pumping power existed, the making of the dam would secure to all a sufficient supply of water up to the end of the summer without the necessity of any addition from the upper river discharge during the time that it is all required for the canals. As it is, the pumping power on the river enables a larger area of land to be sown in the spring than the river is able to provide water for in summer, with the result that, just at the most critical time, there is danger of the crops depending on these pumps perishing, unless the canals alongside come to the rescue. And it is no easy matter to provide water in July in those canals which would be called upon to meet the emergency. But the operation of the Zifta Barrage may be found to be the solution of the problem. If it proves not to be so, then, in times of scarcity of summer supply such as we have had for three successive years, it may still be found advisable to make the Fareskur Sadd. But it must not be forgotten that, if the Zifta Barrage intercepts the spring water between itself and the Delta Barrage, there will be less spring water to draw upon between Zifta Barrage and the Fareskur Sadd, should it ever be made again; so that the principal advantage to be obtained by making it in the past will be lost in the future. Probably the greater proportion of the spring water which collects in the trough of the Damietta Branch rises in the bed in the first few kilometres below the Delta Barrage within the influence of the head of water held up by regulation on the Barrage.

DISTRIBUTION AND DUTY OF WATER.

The distribution of the river discharge to the different Circles is effected by orders, issued from time to time by the Inspector General of Irrigation, fixing the relative levels to be maintained below the heads of the six feeder canals. The discharges of these six canals are taken weekly during summer by the Delta Barrage staff which, having no responsibility in the matter of the irrigation done by the water, is disinterested so far as the results of its measurements are concerned. The discharges being thus ascertained, the Inspector General adjusts them to their correct proportions by modifying the orders as to the levels to be maintained downstream of the different canal heads.

The proportion to which each Circle was entitled in 1902 was arrived at by the following calculation.

The areas of summer crop of 1901, as given by the Finance Ministry, were :—

CIRCLE.	Cotton, etc.	Rice.
	Feddans.	Feddans.
1st Circle	543,344	30,204
2nd „	495,100	14,708
3rd „	253,443	10,472

Assuming that rice consumes double the amount of water that cotton does, the water should be distributed in the following proportion :—

1st Circle	$543,344 + 2 \times 30,204 = 603,752$.
2nd „	$495,100 + 2 \times 14,708 = 524,516$.
3rd „	$253,443 + 2 \times 10,472 = 274,387$.

Allowing 22 cubic metres per feddan for cotton and deducting for pumps on the river one million cubic metres in 1st Circle, two millions in 2nd Circle and half a million in 3rd Circle, we obtain the following figures as the proportion of the river discharge above the Barrage to which each Circle is entitled:—

1st Circle	43.3	per cent—or say	43	per cent.
2nd „	33.7	„ „ „ „	34	„ „
3rd „	23.0	„ „ „ „	23	„ „

On 22nd June, 1902, the level above the Barrage reached its minimum of R.L. 13.60, and the corresponding discharge of the river was probably 29,300,000 cubic metres, as calculated from the discharge curves of the six canals.

On 23rd June, with a Barrage upstream level of R.L. 13.63, discharges were measured in the six canals, and were as shown in the statement below. Column A of this statement gives the levels downstream of the heads, Column B the names of the canals, Column C the measured discharges, and column D the correct discharges according to the proportion arrived at above for the Circles, assuming that the aggregate of the measured discharges represented correctly the discharge of the river at Cairo. The Sharkawia and Basusia Canals of the 1st Circle were left constantly open, and the correct total for the 1st Circle obtained by regulation on the Rayyah Tawfiki and Ismailia Canal Heads.

DATE.	A. R.L.—D.S.	B. Canal.	C. Measured discharges.	D. Discharges which would have been correct.
			c.m. per day.	c.m. per day.
23rd June 1902 Up- stream level of Barrage R.L. 13.63	13.55	Menufia ...	9,937,875	10,172,825
	13.43	Behera ...	6,504,667	6,881,603
	12.95	Tawfiki ...	8,094,686	
	13.27	Ismailia ...	2,819,811	
	13.75	Sharkawia ...	1,669,248	
	13.66	Basusia ...	893,773	
		Total 1st Circle ...	13,477,518	12,865,632
		Total river ...	29,920,060	29,920,060

According to these measurements, the 2nd Circle was receiving 234,950 c.m. too little, the 3rd Circle 376,936 c.m. too little, and the 1st Circle 611,886 too much. But, at this time, the 2nd Circle was obtaining 300,000 c.m. from the Mehallet El Emir pool, and the 3rd Circle was getting 250,000 c.m. from the same source by free flow, besides what was contributed by the turning of one wheel at the Arfeh pumping station : so that, taking these additions into account, the distribution of the available supply was as just as one can ever expect to make it.

Taking the June average river discharge as $30\frac{1}{2}$ millions, and adding $3\frac{1}{2}$ millions for the pumps on both branches and for the water drawn from the Mehallet El Emir pool, it is found that the total available supply was 34 millions. With this supply and a restricted area of rice, a 24 days rotation was necessary. With the same amount of rice, but with an 18 days rotation, the supply would have to be increased to $\frac{34 \times 24}{18} = 45\frac{1}{3}$ millions ; or with rice unrestricted, to 48 millions.

In 1903 the Damietta Sack will not be made, and half of the pumped supply obtained from that branch, or 1 million a day out of 2 millions, will be lost, so that one million only will remain as the pumped contribution. But the Rosetta Branch will give its 2 millions as before. There will, therefore, be left 45 millions as the river discharge required at the Barrage. If, however, the rotation intervals were increased to 21, a river discharge at Cairo of 39 millions would suffice.

A great deal has been said about the diminution of yield due to the long intervals between waterings which have been necessitated by the insufficiency of the water supply consequent on the excessive extension of the area put under cotton; and that the yield is affected appears to be shown by the following figures. Still, though this is probably a true conclusion, caution is necessary in accepting it as such, as unfavourable weather has of late years coincided with severity of rotations, and all the factors affecting the yield are not shown in the statement below.

Year of crop.	Cotton area Lower Egypt.	Yield. Total received at Alexandria, less Upper Egypt arrivals.	Yield per Feddan.	Extreme period of rotations.
	Feddans.	Kantars.	Kantars.	Days.
1894	1,010,726	4,359,233	4.31	
1895	—	4,894,128	—	
1896	1,086,828	5,480,479	5.04	
1897	1,192,665	6,100,487	5.11	
1898	1,179,493	5,229,306	4.43	
1899	1,257,819	6,026,625	4.80	21 days in 2 nd Circle: less in 1 st & 3 rd Circles.
1900	1,258,843	5,100,299	4.06	28
1901	1,291,887	5,937,911	4.60	21
1902	1,293,878	Probably about 5,300,000	Would be 4.10	24
	Estimated	Perhaps	Perhaps	Proposed
1903	1,300,000	6,240,000	4.80	18

It will be interesting to note the results of 1903, when it is proposed, with the help of the reservoir water, to reduce the intervals between waterings to 18.

It is worth remarking that the above figures show that the gloomy forebodings concerning the summer supply of 1900 and the notices issued by the Government forewarning the people of a coming deficiency of water had no effect in arresting the gradual increase in the area yearly put under cotton.

It must be noted that the above figures representing the yield of the cotton are for Lower Egypt only, exclusive of Upper Egypt which contributes in addition about half a million kantars.

PROPOSALS REGARDING DISTRIBUTION AND ROTATIONS FOR THE FUTURE.

As a consequence of previous experience, it has been decided in 1903 to adopt the three-section arrangement of distribution, by which each

section takes water in turn for a third of a full period which has been fixed at 18 days ; so that each section will get water for 6 days and be without it for 12. For canals, however, from which rice is irrigated, two sections are adopted, each section working for four days and stopping for five. The day when neither section works comes after the working of the 1st section, and is utilised for filling the channels of the 2nd section before water is drawn off from them. As the rice full-period is half of the cotton period, a cultivator may, if he likes, raise cotton or rice, or both. Supposing he has an area of 200 feddans to put under crop, he can put it all under rice and irrigate it once in 9 days ; or he can put it all under cotton and irrigate 100 feddans during one turn and 100 feddans during the next, so that one watering in 18 days is given to it all. Or he may put 100 feddans under rice and 100 under cotton. In this case he would irrigate all the rice and 50 feddans of cotton one turn ; and all the rice again and the other 50 feddans of cotton the next turn ; so that, in every case, the rice would get a watering in 9 days and the cotton in 18 days. The cultivator is thus free to plant what he likes.

The foregoing is the arrangement for summer rotations, and it is expected that, with the help of the Reservoir, water irrigation can be conducted according to this programme throughout the summer. It is calculated that this can be done if the river discharge at Cairo is maintained at 37 million cubic metres a day, which corresponds to a level upstream of the Barrage of R.L. 14.00 under the conditions of distribution now adopted for the 6 supply canals. This discharge would be required up to 22nd June. After that it will be necessary for the discharge to rise to 42 millions, corresponding to R.L. 14.25 above the Barrage, from 23rd June to 9th July ; and to 45 millions, corresponding to R.L. 14.50, from 10th July to 19th July. After that the Nile flood will give more than sufficiency.

Flood rotations, which consist in considerably reducing the flood supply in canals at fixed intervals, are accepted now as beneficial. They have usually taken the form of 7 days high supply and 7 days reduced supply, and have been applied more or less effectually in proportion to the amount of attention that the Inspector of Irrigation is able to give to them.

Between the time when the lowering of canal discharges for winter clearances ceases and the date on which summer rotations begin is a period to which rotations have not yet been applied. But it has been suggested that, for short periods at regular intervals, sufficiently high levels should be given to enable those who choose to take advantage

of the opportunity, to irrigate their fields free flow. Mr. Tottenham has enthusiastically adopted the idea, and has arranged to divide the 2nd Circle into sections and to give each section four days high levels, and reduced levels for the following sixteen. His Excellency the Minister of Public Works was the first to intimate to me, from his own personal experience on his own estate, the satisfaction with which the practical working of such an arrangement was welcomed. It has the advantage of making it possible, for all who seize the opportunity, to economise the cost of pumping, and of helping to release those who depend on the tender mercies of large pump owners for their water, from the bondage to which they are often subjected by those who command this form of water-power.

In my Introduction to Sir W. Willcocks' "Egyptian Irrigation", I related how, when the effects of high level irrigation on Lower Egypt was in question, "I had two maps made up by the Inspectors of Irrigation to show the areas irrigated respectively by free flow and lift at a different seasons of the year, one map to refer to the time preceding the restoration of the Barrage, and the other to the time succeeding it. The conclusions drawn from a study of these maps were that the increase, since the Barrage restoration, of the areas of winter and summer *flush* irrigation was decidedly small." One of the reviewers of the book was puzzled by this statement and, I fancy, hesitated to credit it, in view of the fact that the restored Barrage gave such superior command over the water levels as compared with that existing before the restoration. But the map justified the conclusions, nevertheless; and the probable explanation of the difficulty lies in the absence of banks to canals. When the water levels were low in the days before the Barrage restoration, free flow was impossible in most canals, as the water never rose to country level in the channels. Consequently the banks were of little service and were removed for private uses by whosoever chose without protest from a negligent staff of engineers. So that, when the Barrage was restored and gave us the power of producing better levels, it was found impossible to give them, as the canals had no banks to confine the water. It is only now that canals are having their banks restored, and this improvement in distribution is becoming possible. But the habit of removing the banks to spread the earth on the fields has become such a custom of the country that Mudirs and sometimes native engineers look upon the efforts made to put a stop to the practice as acts of oppression on the part of the Inspector who has made up his mind to put and keep his canals in proper working order. As I have said elsewhere in this Report, the

determined efforts, first made in the 2nd Circle, to introduce this reform, are producing satisfactory results : but it has been made abundantly evident that little progress in this direction can be hoped for without a large expenditure of energy, on account of the universal habit which has to be overcome and put an end to.

It is not intended to give "heavy and high-level irrigation throughout the year," but to give high-level irrigation for short periods alternating with longer periods of low levels. I still consider the following passage in my annual Report for 1896 lays down sound principles on this point: "During flood it is desirable to be liberal with the red water supply and to deliver it abundantly to all parts of the country. At the same time, infiltration must not be overtaxed. Free flow irrigation is a necessity for washing salt out of bad lands and for keeping down the cost of raising crops on lands which would give no profit, were lift irrigation only possible in their case; but free flow means high level and an increase in the drainage water to be run off; continued high levels also waterlog the soil and render it sour. Rotation produces high and low levels alternately, keeps the water in the soil from stagnating, gives free flow during one period and provides for helping the drain the next, and is undoubtedly the most healthy system to adopt for water distribution in a country such as Lower Egypt is."

DUTY OF WATER.

The period chosen for the calculation of the "summer" duty of 1902 is the 50 days from 19th May to 7th July inclusive, as, during that time, the variations in the river discharge at Cairo were slight. This period embraces more than two full periods of rotation and is therefore sufficiently long to give a true result.

The mean discharges of the main canals for the 50 days are obtained by finding the mean water level for the period, and from it the corresponding discharge shown on the discharge diagrams drawn with the help of all the observed discharges during the summer. The figures thus found are the following:—

CANAL.	Mean W.L.	Corresponding discharge.
	R.L.	c.m.
Rayyah Behera	13.54	6,820,000
Rayyah Menufia	13.65	10,800,000
Rayyah Tawfiki	13.08	8,600,000
Canal Ismailia	13.49	3,300,000
Canal Sharkawia	13.87	1,400,000
Canal Bususia	13.80	800,000
Total representing river discharge at Cairo: Mean of 50 days.		31,720,000

DUTY OF WATER—LOWER EGYPT.

The areas under summer crops in 1902 are given by the Finance Ministry as under :—

CIRCLE.	Summer Rice.	Cotton and Summer Crops other than rice.
1st Circle	41,114	528,853
2nd "	16,783	499,500
3rd "	21,734	265,525
Total	79,631	1,293,878

The supply of water available for the irrigation of these crops is thus made up :—

	Cubic metres. a day.
Total of 6 Canals	31,720,000
Lifted by river pumps below Barrage	3,500,000
Contributed in addition by Mehallet El Emir pool... ..	380,000
Total	35,600,000
Deduct for Alexandria	41,000
Deduct for Port Said and Suez	70,000
	111,000
Balance total available	35,489,000

In previous years it has always been assumed for the purpose of calculating the duty of water that rice takes a fixed 40 cubic metres a feddan. But it would seem more correct to assume that rice takes

double the quantity of water that other crops do. The calculation of the general duty is then made in the following way:—

$$\frac{\text{Total available supply } 35,489,000 \text{ c.m.}}{\text{Rice } 79631 \times 2 + \text{other crops } 1,293,878} = \frac{35,489,000}{1,453,140} = 24.42 \text{ c.m. per day per fed. of crop.}$$

A feddan of rice would, under the assumption, require 48.84 cubic metres a day, while a feddan of other summer crops would require 24.42 cubic metres a day.

By calculating in the same way for each Circle separately we get a test of the fairness of distribution. If all the "duties" work out the same, the distribution has been perfect. The following calculations will show that the distribution was not far from being perfectly fair.

DUTY OF WATER—1ST CIRCLE.

The crop areas were:—

	Feddans.
Summer rice	41,114
Cotton and other summer crops	528,853

The mean summer discharges were:—

Rayyah Tawfiki	8,600,000
Canal Ismailia	3,300,000
Canal Sharkawia	1,400,000
Canal Basusia	800,000
	<hr/>
River pumps	14,100,000
	<hr/>
	1,000,000
	<hr/>
	15,100,000
Deduct for Port Said and Suez	70,000
	<hr/>
Total available supply	15,030,000

Doubling the rice area 41,114, and adding the product to the area of other crops 528,853, we get 611,081.

The general "duty" is, therefore, $\frac{15,030,000}{611,081} = 24.60$ cubic metres.

DUTY OF WATER—2ND CIRCLE.

The crop areas were:—

Summer rice... ..	16,783
Cotton and other crops	499,500

The available supply was:—

Rayyah Menufia	10,800,000
River pumps and Mehallet El Emir pool	2,100,000
	<hr/>
Total available	12,900,000

The general "duty" is, therefore, $\frac{12,900,000}{16783 \times 2 + 499,500} = 24.20$ cubic metres.

DUTY OF WATER—3RD CIRCLE.

The crop areas were :—

	Feddans.
Summer rice	21,734
Cotton and other crops	265,525

The available supply was :—

Rayyah Behera	6,820,000
River pumps and Mehallet El Emir pool	780,000
	<hr/>
	7,600,000
Deduct for Alexandria water supply	41,000
	<hr/>
Total available	7,559,000

The general "duty" is, therefore $\frac{7,559,000}{21,734 \times 2 + 265,525} = 24.46$ cubic metres.

Collecting these results we get this comparison :—

	General duty	Rice duty
Lower Egypt as a whole	24.42	48.84
1st Circle	24.60	49.28
2nd "	24.20	48.40
3rd "	24.46	48.92

The "duty" of water, as above expressed for Lower Egypt as a whole, means that a daily discharge of 24.42 cubic metres was consumed per feddan of standing cotton and other crops, and 48.84 cubic metres per feddan of land planted with rice. As, for the period of 50 days used in the calculation, the average interval between waterings of cotton was 22.74 days, a single watering of a feddan of cotton took $(22.74 \times 24.42 =)$ 555 cubic metres of water; and 11 days being the interval for rice waterings, a single watering of a feddan of rice took $(11 \times 48.84 =)$ 537 cubic metres of water.

In "Egyptian Irrigation" (Willcocks) 2nd Edition p. 365, the summer duty of water is given as 22 cubic metres for cotton, allowing for a watering every twenty days. The author obtains this figure by allowing 350 cubic metres an acre per single watering of $8 \frac{1}{2}$ centimetres depth, with an additional allowance of 5 cubic metres a day per acre to allow for waste. His full allowance for a single watering per acre is, therefore, $(22 \times 20 =)$ 440 cubic metres.

This, however, does not agree with the calculations now made, which give 555 cubic metres as required for a single watering per acre. The

rotation period now being adopted in 1903 is 18 days. Working with this period and allowing the same quantity for waste as is allowed in "Egyptian Irrigation," but allowing 550 cubic metres for a single watering per feddan, a canal in summer should discharge ($\frac{1}{3} \frac{60}{8} + 5$) = $30\frac{2}{3}$ c.m. per 24 hours per feddan of cotton to be irrigated, which allows a watering of 11 centimetres depth and for waste as before; or, in other words, allows 552 cubic metres per feddan per watering inclusive for waste.

It is, however, the general opinion that the Finance figures of crop areas are less than the actual areas, so that I think it would be quite safe to lay down that, with an eighteen day rotation, an allowance of 80 cubic metres per feddan of rice crop, is fully sufficient.

In the 1900 Report it was calculated that 22 cubic metres a feddan was a sufficient allowance with a 21 day rotation, equivalent to $25\frac{2}{3}$ cubic metres with an eighteen day rotation. In that year the water supply was stretched to the utmost, and it is possible that the full area of crop, as given by the figures used in the calculations, was not irrigated. With the uncertainty then that there is about crop areas, it is not possible to calculate the "duty" of water exactly; but I think this conclusion may be drawn, namely, that an available daily supply at the rate of 30 cubic metres per feddan of cotton and 60 per feddan of rice crop is fully sufficient to allow of waterings being given to the cotton once every 18 days, and to the rice once every 9 days: and further, that, under conditions which favour the economical use of the water, it may still be possible to carry out the irrigation under an 18 day rotation programme with the daily supply reduced to 26 cubic metres per feddan of cotton; but only on the condition that no rice growing is allowed for, as arrangements for rice growing would be opposed to conditions favourable to the economical use of water.

If the supply falls short of the allowances calculated above there is nothing for it but to lengthen the intervals between waterings, or to reduce the area of crop to be watered.

We have in these new calculations the reconciliation between Mr. Verschoyle's opinion recorded on page 143 of the Irrigation Report of 1899 and the conclusion arrived at on p. 153 of the 1900 Report. For if rice growing is unrestricted, and if waterings are given every 18 days to cotton and every 9 days to rice, an allowance of 30 cubic metres a feddan per day is necessary for cotton and double that for rice. This figure of 30 cubic metres is that which Mr. Verschoyle stated that cotton requires. If again, as is shown above, rice growing is not provided for, an allowance of 26 cubic metres for cotton will be sufficient

to allow waterings every 18 days : which is equivalent to 22 cubic metres and waterings every 21 days.

CROPS.

The yield of the cotton crop of 1902 will probably amount to 5,700,000 kantars for all Egypt. On 3rd April 1903 the arrivals at Alexandria had reached the figure of 5,661,588 kantars. The arrivals up to the end of August are assumed to belong to the crop of the year before. The following figures give the yield of the cotton crop for all Egypt year by year since the Barrage restoration:—

Crop of 1891...	...	...	...	...	4,765,341 kantars.
" 1892...	...	...	...	...	5,220,510 "
" 1893...	...	...	...	...	5,033,235 "
" 1894...	...	...	...	...	4,619,233 "
" 1895...	...	...	...	...	5,265,128 "
" 1896...	...	...	...	...	5,879,479 "
" 1897...	...	...	...	...	6,566,487 "
" 1898...	...	...	...	...	5,583,306 "
" 1899...	...	...	...	...	6,440,625 "
" 1900...	...	...	...	...	5,474,299 "
" 1901...	...	...	...	...	6,369,911 "
" 1902...	...	...	about...	...	5,700,000 "

There has, therefore, been no marked permanent advance since 1896, but this is not surprising considering the bad summer supplies we have had in 1900, 1901 and 1902. It is a matter for congratulation that, under such circumstances, the yield has always been in excess of the yield of any year previous to 1896. I think it not improbable that, in consequence of the Reservoir contribution to the summer supply of 1903, a yield of 6 $\frac{1}{4}$ million kantars may be obtained, but much depends upon the weather in August and September.

It appears from reports received that the 1902 crop suffered from unfavourable climatic conditions. The Behera Company, in its Report on the operations of 1902, states that the cotton crop has unfortunately suffered much from fogs. The Inspector of Irrigation of 1st Circle reports the same, but implies that the damage was not universal.

Other crops are reported to have been satisfactory, especially the dura crop, which the acting Inspector of the 2nd Circle states was unusually abundant. He also reports that the winter crops were sown three weeks earlier than usual on account of the early ripening of the cotton and dura crops, which fact he ascribes to the temperature of the months August, September and October.

LAKE VICTORIA NYANZA GAUGES.

The information about the Lake Victoria gauges reaches Egypt irregularly. The latest reading received is from the Port Alice (Entebbe) gauge, which read 4 ft. 2 in. on 31st December 1902. So far as the information received allows, the comparison of the Lake levels from year to year is made in the following statement:—

YEAR.	Port Alice (Entebbe.)	Port Victoria, Ugowa and Kiennu.	Lubwa and Jinja. (Jinja.)
	Ft. In.	Ft. In.	Ft. In.
1st October, 1898... ..	3 2	3 2½	3 1½
1st October, 1899... ..	2 6½	2 2	1 5
1st October, 1900... ..	1 7	1 1	1 0
1st October, 1901... ..	Not received.	1 8	1 5
1st October, 1902... ..	3 5	Latest received 31st March.	2 3 (30 Sept.)

It appears from the Port Alice gauge that the Lake is as high as it was in 1898, having risen nearly 2 feet above the level of 1900. The Lubwa-Jinja gauges show that the Lake is 2 feet lower than in 1898, and that it has risen only 15 inches above the level of 1900. The gauges have been changed at each station more than once; and as they are not referred to any datum, the accuracy of the re-fixing of the new gauge is more than doubtful. It is hoped that Sir William Garstin will bring back with him from his expedition to these Lakes the information that is wanting about them.

SUEZ FRESHWATER CANAL.

The condition of the Suez Freshwater Canal gave rise during the year to complaints which an inspection of the canal showed to be well founded. The bed level of the lower half of the canal had been allowed to become too high, the channel was found to be choked with masses of a weed which grows freely on the canal bed, and the banks were in places too low and weak. The medical officer of Suez complained that the water was rendered salt in consequence of rain water collecting and standing against the right bank. The necessity of providing syphons to pass this rain water forward under the canal was recognised some years ago when both railway and canal banks were breached, but the order to submit projects was not carried out.

To put the canal in proper order instructions were given to introduce a second Priestman's dredger into the canal to clear the bed to fixed levels and widths, to make up the weak portions of the banks to full heights and widths, and to provide long handled rakes for clearing out the weeds. At the same time the local engineers were to be kept up to their work by the Inspector. The projects for the syphons to carry off the rain water were to be sent in without further delay. It is hoped that the carrying out of these instructions will result in the canal being brought into a satisfactory state. Its neglect is probably due to the fact that it is distant from all the usual lines of inspections and, although of first importance to Sucz, it is nevertheless of local interest only, and, in consequence, has not had sufficient attention bestowed upon it.

DRAINAGE.

In a note from one of the irrigation officers that came before my notice during the year, I was somewhat staggered to find that he seemed to take credit to himself for having introduced rotations on drains, as though it was in principle a good system to apply to drains, as it is acknowledged to be a healthy process in the case of canals. Such a creed can only be condemned as rank heresy. The flow of a drain should never be stopped; and its section should be sufficient to discharge, with a W. S. level at a favourable depth below soil, the maximum discharge due to the drainage of the area served by it. If the drains of liberal section are abused, and are flooded by an excessive quantity of water being poured into them, the remedy should be to shut off the outlets of canals whence the water *starts* on its way to the drains. It is not an easy thing under present conditions to control the quantity of water taken from canals, and effective control will not be obtained till the public canals are provided with properly designed outlets. Mr. Dupuis, the Inspector of Irrigation of 2nd Circle, never loses an opportunity of enforcing this necessity. Land under rice, or under reclamation by washing, cannot be allowed an unrestricted supply of water, if the drains into which they discharge are to remain efficient as drains. A certain *reasonable and sufficiently liberal* quantity per feddan should be allowed, and it should be left to the cultivator to choose whether he will use the allowance to irrigate a large area of a crop that needs comparatively little water, or a smaller area of rice, or to wash land under reclamation in the hope of future benefits. For example, a cultivator of land draining into Lake Mareotis should not be allowed,

however much he may wish it, sufficient water to irrigate, say, one third of his land under cotton and one third under rice, and also to wash the remaining third, while he contributes nothing beyond the ordinary land tax towards the cost of pumping the resulting drainage.

It seems that the only way to keep the quantity of water, which has to be pumped at Mex, down to a reasonable figure, is to adopt some system of restriction of supply. After the restoration of the Barrage and the remodelling of the Rayyah Behera, the water supply of the Behera Province was so much improved that the difficulty of keeping the Mareotis Lake levels down commenced. The more recent improvement in the efficiency of the Barrage and the consequent increase in the canal discharges have had a continuous effect in increasing the quantity to be pumped at Mex. The increase has also been aided by greater facilities of drainage and by a decrease in evaporating area consequent on extended drainage. Control must now be exercised over the supply, and care be taken that discharges, in excess of what provide a fair allowance for the area to be irrigated, be not allowed to enter the canals. The pumping station at Mex cannot be enlarged except at a prohibitive first cost, and the annual cost of pumping is already over £E.13,000. The quantity pumped in 1902 was 385 millions, whereas in 1899 it was 285 millions, and in 1896, 175 millions; which gives an increase of 100 millions for each period of 3 years—a serious matter. The Inspector of Irrigation has been instructed to turn his attention to the restriction of the supply of water to lands which drain into Mareotis as the most practical way of meeting the difficulty. The privilege of cultivating land below sea level and of having drainage provided by pumping into the sea at the public expense should be kept within bounds. Behera Province, for the most part, gets free flow irrigation and free flow drainage (Government doing the pumping, and landowners gaining lawsuits against Government for not doing more than it does.)

The system of embanked public drains flowing by gravitation to the sea, into which landowners can pump their own drainage, is a more satisfactory system, certainly from the public treasury's point of view, than the existing arrangement for the Mareotis drainage. There is a large area of land uncultivated and untaxed in the north of the Delta, which is only a little below the level of land which it is possible to cultivate. If the owners of such land were to pump their drainage, the land would be readily cultivable, provided there be a public drain within reach to pump into. All that is required is to surround the land by a bank with an interior ditch to act as catch drain and to set up a

pump or pumps at the most convenient points for pumping the drainage into the public drain. Such low-lying lands would always be able to get their irrigation effected by free flow. It has been urged against such an arrangement that the expense of pumping the drainage water would be too great for the operations to be profitable; but, if it pays to lift water for irrigation to raise crops on high lands which get free flow drainage, it must pay to have free flow irrigation and lift the drainage water, as the amount drained off the land must of necessity be less than the amount used in irrigation; how much less will depend upon the care with which the irrigation is conducted. The diagram on plan VIII shows in a simple form the system advocated as applied on a small scale.

But there is no reason why this system should not be applied on any scale to the low lands bordering the lakes. Combined with a system of shallow inundation basins, which Sir William Willcocks has frequently advocated as the proper method of reclaiming these lands, I believe much might be done. During flood the land would be inundated and, given a good soaking, the water lying on the land being changed to the extent that the available water supply might render possible. At the end of October or during November this water would be escaped, and pumps be then used for completing the drainage, so that winter crop could be put in.

As a suggestion for the application of this system, I have shown on plan VIII the proposed method applied to an area of about 28,000 feddans lying to the north of the Bahrs Adma and Rogham, and bounded by the Samatay and Waziria Main Drains, the banks of which would form the boundaries of the area, connected by a bank on the north between the tail of Samatay Drain and Waziria Drain. On the inside of these banks a graded drain would be dug leading to the pumping station at the north west corner, where a masonry escape also would be built. A head sluice on the Bahr el Adma would be built to regulate the supply of water admitted into the enclosed area for washing and irrigation. A second escape would be made in the north bank, either where shown or more to the east.

To reclaim the land enclosed, the method of proceeding would be as follows:—During the flood when water was plentiful, water would be supplied through the head sluice to inundate the whole area, the water level of the inundation being regulated by the opening and closing of the escapes. The second escape is provided in order to give the power of altering the direction of flow across the inundated lands, so that the benefits of the inundation, as a washing and colonatising process, may be more evenly distributed.

In November, or at the most convenient season, the canal supply would be shut off, and the two escapes be fully opened to discharge as much as possible by gravitation. On the escapes ceasing to discharge, they would be completely closed on the lake side (with earth saddles if necessary), and the rest of the drainage would then be effected by the pumps, which would keep the water level constantly low enough to be cultivated. A well conducted experiment on a large scale, made after the manner described, would, I think, be worth making.

The reason why no definite project for the reclamation of these lands has yet been elaborated by the Irrigation Service is that no maps exist of this inaccessible country, and we are still waiting for them. The project, suggested as an example, must only be taken as an illustration of the principle advocated, and not as a proposed project for execution, as such a project can only be prepared when better maps are made available, and more is known about the actual features of the country to be treated.

With reference to the question of pumping the drainage water, I think Sir W. Willecocks' warning concerning large areas drained by single installations worth quoting. The quotation is from his lecture of 25th March, 1903, on Irrigation on the Tigris. "The important point is, that numbers of small pumps should be placed on the banks of the main drains, draining small areas and discharging direct into the mains. Such pumps should be actuated by one central electric station for reasons of economy. The results of such drainage would be immediately apparent. The early failures of large reclamation works were nearly always due to the extensive areas drained by single installations. Electricity to day has come to the aid of drainage as it has to that of every department of industry in the world." The question is also discussed on pages 394 to 399 of Willecocks' *Egyptian Irrigation* 2nd Edition, where the author lays down that "the most economical area to drain with one pump is 2500 acres."

THE ASHTOOM OR BOGHIAZ OF BORILLOS.

Attention was called during 1902 to the condition of the outlet of Lake Borillos, and it was visited and reported upon by Mr. Grieve and also by one of the Behera Company's staff. It is extremely difficult to obtain any reliable information concerning this outlet from the people who live alongside. Either their powers of observation are wholly undeveloped or their self-interest is so strong in its action on their imaginative powers that their statements become so confused and

inaccurate as to be worthless. The few observations made by reliable officers and placed on record are, therefore, all the more valuable. The records are to be found in the Irrigation Reports as below :—

Report of 1886...	...	...	pages 49 to 51 and 61 to 65
..	1895...	...	page 122
..	1896...	...	" 128
..	1897...	...	" 150

In 1886 Sir W. Willcocks proposed the closing of the Bahr Saidi, which has been done, and also the dredging of the outlet, (which has not been done), as the two measures necessary to make the lake during flood "keep the same limits and at the same height as Lake Borillos during winter, i.e. at sea level."

After reading all the information there is about this pass (which I myself visited twice in 1895), I have come to the conclusion that there has been no great change since 1886 in the condition of things at the outlet, except that the sand bar has become broader and the channel formed through it at the end of the year is narrower and shallower, and that it is formed a month or two later. Sir W. Willcocks in 1886 reports that "this opening is closed by drift sand during the months of May, June and July. During August and September the lake rises with flood water until it is about one metre higher than the Mediterranean, then it either bursts the bar or it cuts through it, and its level falls half a metre." The closing of the Bahr Saidi, and other steps taken to control the amount of water poured during flood into the lake, appear to have had the effect only of retarding the date at which the lake rises high enough to cut out its channel of discharge. It also appears that the channel formed by the escaping water has less than half the water way of the channel of 1885, which Sir W. Willcocks reports had 500 square metres cross section. M. Grieve, on the 11th February 1903, found the channel to have a section of 168 square metres.

I think Sir W. Willcocks was right in his recommendations, and the chief thing to aim at is not to allow the lake to rise above mean sea level; and I have, therefore, recommended the following policy for the Inspector of Irrigation of 2nd Circle to adopt. Leave the pass alone and let the sea flow in and out. If the pass closes itself, then, between the time of its becoming closed and the following October or November, dredge out a channel in still water, making, if necessary, an artificial closure against the sea at the sea-ward end of the channel to facilitate dredging operations by producing still water. When, in consequence

of the drains discharging during and after flood, the lake level begins to rise above sea level, the sea-ward sodd should be cut; the flow-out will then keep the passage open and the lake will not rise above sea-level. By adopting such a course, the fisheries will not be interfered with, the drains will work properly in the winter when they are most needed, the land above sea-level will not be inundated every November or December, and the reclamation of the lands bordering the lake, now uncultivated on account of the yearly recurring inundation, can be undertaken by the application of the method advocated in this Report for lands bordering the lakes. A wide strip of low lands, lying between the edge of the lake when at sea-level and of a contour 70 centimetres above sea-level, would become reclaimable; and, as the land in the north of the Delta is very flat, there must be a very large area of land between these levels.

CHAPTER II.

FLOOD SEASON.

The summer, of which the preceding chapter treats, was the third of three low summers which have followed three successive low floods. And now there has been a fourth low flood in 1902, probably also to be followed by a fourth low summer in 1903. Will the procession not end until the full tale of "seven ill-favoured and lean fleshed kine" have come up out of the river?

It seemed in August as if the coming 1902 flood would prove to be the very worst on record, as the Aswan levels up to 5th September were lower than any previous flood of which we have knowledge. Fortunately the later stages of the flood in September and October were better than the early prospect, and the flood eventually proved to be a slight improvement on that of 1899—which was bad enough. But the extremely low levels of its early periods retarded the sowing of dura in Giza, and made the filling, and consequently the emptying of the basins abnormally late. It is feared that this delay, combined with the early cold of December, will seriously affect the winter crops in the basins of Giza Province.

But the Delta, north of the Barrage, is insured against the deficiencies of a low flood by the operation of its Barrage and weirs. More use was made of the power of controlling the river levels by the Barrage than ever before. Particulars of the regulation will be given in the chapter on the Delta Barrage.

GIZA PROVINCE.

Both West and East Giza were in a better position as regards their means of irrigation than they were in 1899. Since that year the improvements, referred to on p. 166 of the 1900 Report as being in hand, have been completed.

West Giza.

In West Giza the Aguz Escape has been converted into a head to the Giza Canal. The Regulator in Saliba Saqqara has been given efficient closing apparatus, and a group of regulators connecting Saqqara Basin and the Giza Canal have been built at Bedreshen. The Giza Canal has been prolonged northward and passed in syphons under the Abu Nimros Escape and Zummur Canal. The Zummur Canal has also been prolonged and passed in syphon under the Rayyah Behera to join up with the Um Dinar Canal.

These improvements enable water to be drawn in from the river at three points instead of one. The Giza Canal is used to fill up Saqqara Basin in early flood without giving anything away to Giza Canal, which is fed by its new Aguz Head. As Saqqara Saliba Regulator can now be tightly closed, Shubramant Basin can be kept empty, so as to create a draw in from the river through Abu Nimros Escape for the filling of Manshia and Iswid basins. By the construction of the Bedreshen Regulators it is arranged that if there is a surplus in Giza Canal reaching Bedreshen, it goes to fill Saqqara basin. If there is a deficiency, and more is wanted for the Giza Canal north of Bedreshen, the regulators provide for the deficiency being made good from the water stored in Saqqara basin, so that there is always an assured supply for the Giza Canal on the north.

When the river has fallen so low that there is no longer any draw-in from the river at the three points named, the heads and escape are tightly closed. The completion of the irrigation has then to depend on the water passed on by the Beni Suef chain of basins. When the Aguz Head is closed, the Giza Canal Head draws from the Maarkab Basin.

The Komi Bridge in the saliba of Riqqa Basin is the regulator through which the Beni Suef water is passed on into the Giza basins. There is an important matter concerning the regulation of this bridge, which should be recorded in case there should be another low flood before the basins are converted into Sefi tracts. The Girza Head and Komi Bridge both discharge into the same channel within two kilometres of each other, so that a heavy discharge through Komi checks the draw-in through Girza Head. Such being the case, and as Komi Bridge belongs to Upper Egypt and Girza Head to Lower Egypt, it was thought advisable for the two Inspectors General to agree together as to what should be done to make the best of the bad flood that, as early as the end of July, seemed to be a certainty; and, having agreed, they issued definite instructions accordingly as to the manner of handling Komi Bridge. The instructions decided on were based on the experience gained in the low flood of 1899, and did not sufficiently allow for the effect of the transformation of the Assiut and Minia basins which had since taken place. It was assumed that the discharge through Komi Bridge, due to the flow-in through Koshesha Escape supplemented by the Bahr Yusuf surplus, would give Giza a better supply than could be drawn in through the Girza Head. The quality of the water would not be so good, but it was felt that quantity must be the first consideration in a flood that was certain to be very deficient. But because of the changes in Middle Egypt and the expansion of the Fayum, the Bahr Yusuf had no surplus to give to Koshesha Basin. Consequently nothing was gained by drawing in the supply through Koshesha Escape, and passing it on through Riqqa Basin and Komi Bridge, over what would have been obtained by closing Komi Bridge and creating a draw in through the Girza Head. For the river between Koshesha Escape and Girza Head now takes a straight course, and there is no gain of level at Komi by using the basin route for supplying Giza. The result of the arrangement was that the discharge, which might have been drawn in through the Girza Head, had Komi been closed, was so much water lost of the possible total supply of the basins. In future, under the conditions that exist, it will be better to keep Komi Bridge tightly closed and to draw in as much as possible through Girza Head in early flood, only closing the latter when the flow-in ceases and the time is come for passing on water through Komi to complete the irrigation of Giza Basins. The discharge, drawn in through the Koshesha Escape, can then be kept in Riqqa Basin where it will be available to complete the irrigation of the Giza Basins at an earlier date than could otherwise be—a matter which is of considerable importance to Giza, as, in a bad

year, it depends entirely, during the later period of the flood, on Riqqa Basin for the supply necessary to finish the filling of its basins.

The inundation and discharge of the main chain of basins in West Giza was on the whole satisfactorily managed by Mr. Finlaison and his Chief Engineer, though the date of the final operations of discharge was unfavourably late. This drawback it was not altogether possible to avoid, being a consequence of the nature of the flood in the river which is not under our control. The discharge of the basins was effected by means of masonry regulators and escapes, with the exception of one cut which it was found necessary to make in the Menshia Saliba. But I am not without some misgivings as to the wisdom of this policy of avoiding cuts in 1902. The flood being so late, every thing should have been done to complete the inundation of the basins in succession and then to get rid of the water as quickly as possible. The inundation of the tail basin, Hod El Iswid, was not complete until 3 days later than in 1899, so that, whereas the Nikla Sadd was out on 6th December in 1899, it was not cut till 9th December in 1902 in spite of the improvement in the means of filling the basins already described. Possibly the supply passed on into Giza from Beni Suef was less in 1902 than in 1899, and this may account for the delay; or it may have been due to the fact that the flood, in all its phases, was 10 days later in 1902 than in 1899. More cuts in the salibahs might, however, have gained four or five days, but even this is doubtful and it is still more doubtful if the gain in time would have been worth the subsequent expense of closing the cuts and the damage that such cuts cause to the land in their neighbourhood.

The inundation of the chain of hoshahs between the railway and river alongside the Giza Canal was much facilitated by the numerous culverts built since 1899. It was carried out more successfully than in previous low flood years with a welcome absence of disturbing breaches and mistakes. Perhaps this may be attributed to the more undivided attention that the controlling officer is able to give to the details of distribution now that the Giza Province is placed under the care of the Director of the Delta Barrage.

The extensive areas outside the Nile banks " Sahels " known by the names of Kafr Turki, Bemha, Abu Rawan, Marazeeq and Turfaya, amounting altogether to some 1,800 feddans, were surrounded by hoshah banks and irrigated with the high level water of the basins passed through the Nile bank, as they are at much too high a level to be directly inundated from the river in a low flood year. It would be advisable to make all or, at least, most of these banks permanent.

East Giza.

Since 1899 East Giza has been given a second point of supply from the river at Ghamaza, and some syphons and escapes have been built to improve the means of distribution. Consequently East Giza was, on the whole, considerably better off than in 1899. But "Sharaqi" at its southern end is unavoidable in a low flood year, and it is estimated that there were something less than 20,000 feddans unirrigated in 1902. In 1899 the figure was about 30,000.

The most effective way of improving the condition of East Giza under the present system of irrigation is to remodel the Khashab Canal at its head, and give it ample width and depth, so that it may discharge freely even in a bad Nile. A project has been made out for this work, which it is intended to put in hand in 1903. But East Giza has a possible prosperous future before it as compensation for a past of comparative poverty. In my opinion the best method of bringing about such a future is for Government to set up and work one or more pumping stations, and to give summer water free, recouping itself for the expenditure involved by an increase of land tax of at least P.T. 50 per feddan over the whole area, on the same ground that a like increase is imposed on the basin lands of Middle Egypt which have been, or are being, converted into "Sefi" cultivated lands with free flow irrigation.

The configuration of the cultivated area of East Giza seems to me to favour the scheme of two pumping stations, one at Khorman and the other at Saff, rather than one single large station at Khorman. The cultivated strip of land between the river and the desert seldom exceeds 4 kilometres in width, and never exceeds 6. Its length is from 50 to 60 kilometres. If two pumping stations are made, the south one would be at Khorman and the north one at Saff, 30 kilometres from the former. Both these could be under one Chief Engineer, as there is no doubt that the development of the agricultural possibilities of this region will lead to the execution of the proposed prolongation of the Helwan railway as far as Khorman. There would then be convenient means of transport by railroad or river for the produce of the land to Cairo, the proximity of which will help to enhance the value of the crops. As, also, East Giza enjoys climatic conditions, due to its situation between Upper and Lower Egypt, favourable to the growing of cotton or sugar cane (as has been demonstrated on the Bedreshen Estate), its advantages as a "Sefi" crop region are great. Such being the case, I think there can be little doubt that the endowment of East Giza with Government pumping stations to give it summer water would at least double the present value of the land.

I should strongly recommend that the pumps should not be allowed to make use of the Khashab Canal as a channel for carrying pump water, but that this canal should be reserved and maintained exclusively as a flood canal, always ready to give as liberal a supply of red flood water to the lands as the flood levels of the river may permit. The pump water should be conveyed in the branch canals, of which the West one runs generally along the high land just inside the Nile bank. The land on the east of the Khashab Canal could be irrigated from branches to which water would be carried across the Khashab Canal by means of aqueducts at Khorman and at a point south of Atfih in the South section; and at Saff and Ghammaza in the North section.

The administration of the irrigation would be conveniently provided for by making East Giza a separate Chief Engineership of two Districts, the South District extending from Khorman to Saff and the North from Saff to Cairo.

West Giza's future is assured by the decision to extend the Ibrahimia system of canals northwards in order to convert it into a Sefi province. The preparation of the project for this conversion has been entrusted to Sirry Bey, as he has a trained staff under his orders, and the work is a continuation of what he has been doing in Assiut, Minia and Beni Suef Provinces.

FLOOD WATCHMEN.

For the second year in succession no unpaid flood watchmen were called out anywhere in the Delta to guard the Nile banks or for other purposes. But in Giza Province it will always be necessary, even in the worst floods, to turn out men to watch and protect the basin banks, until the conversion of the irrigation system from flood to perennial irrigation abolishes the basins themselves and their banks. In 1902 the flood watchmen called out in Giza Province numbered on an average 368 men for 30 days, equivalent to 110 men for 100 days. This is less than ever before; and it would appear from Mr. Finlaison's report that he considers that, in the endeavour to keep the figures as low as possible, he carried reduction a little too far, as "the saliba banks of Dahshur, Saqqara and Shibrmant were very considerably eroded, in some places dangerously so." It is no doubt possible to overdo the policy of reduction of corvée numbers, and it is here that the judgment of the officer in charge of the Circle or Directorate must be exercised in order that he may not reduce below the limit that is necessary for security.

The Giza figures for the past four years have been as follows:—

YEAR.	Numbers of flood watchmen Giza Province.
1899	337 for 100 days
1900	735 " " "
1901	161 " " "
1902	110 " " "

The years 1899 and 1902 were years of similar flood. In 1899 the numbers of flood corvée, turned out in Lower Egypt and Giza combined, were 726 men for 100 days; in 1902, as has been stated, 110 men for 100 days. Further reduction is scarcely advisable until basins are abolished; possibly even with such reduced numbers the factor of safety is too low, and increase may be what is more conducive to the welfare of the greatest number.

NILE GAUGE OBSERVATIONS.

The rate of travel of a rise or fall of the river from Khartoum to the Delta Barrage (a distance of 2763 kilometres) was clearly ascertained during the flood of 1902 by a study of the levels reported from the different gauge stations. The rate of course, becomes more rapid as the river rises. It was found to be as given below for different levels at Khartoum.

Date and level at Khartoum.		From Khartoum to Berber.	From Berber to Halfa.	From Halfa to Aswan.	From Aswan to Suhag.	From Suhag to Delta Bar- rage.	Total Khartoum to Delta Barrage.
		Days.	Days.	Days.	Days.	Days.	Days.
11 May ...	−0.07	5	15	6	7	9	42
1 June ...	+0.10	4	12	5	6	7	34
17 June ...	+0.62	4	12	3	6	7	32
2 July ...	+1.87	4	11	3	5	5	28
9 Sept. ...	+5.40	2	5	2	2	3	14

The last level but one of the above table, namely +1.87 on the Khartoum gauge, produced a level of R.L. 15.50 at the Delta Barrage 28 days later. This is important to note, as it is after reaching this level of R.L. 15.50 that the more or less gradual opening of the Barrage gates begins.

The maximum at Khartoum was attained on a later date than the maximum at Berber, but it was probably the level of 9th September at Khartoum, combined with the effect of the Atbara flood, which produced the maxima at points lower down. The rate of travel of the maximum is also given above.

The maximum reached at Aswan was 14 pics, which it will be seen, followed a level of R.L. 5.40 at Khartoum after an interval of 9 days, another fact worth noting.

A high flood, producing a level of 17 pics at Aswan, would probably travel from Khartoum to the Delta Barrage in 10 to 12 days.

The maximum of the 1899 flood at Aswan was 13 pics 22 kirats of the 4th September, a difference of 2 kirats, or $4\frac{1}{2}$ centimetres, from the maximum of 1902. The flood of 1902 was very similar in its levels and phases to that of 1899, but was on an average ten days later. The diagram of the Aswan gauge shows flood curves for the two years almost truly parallel. It appears from this diagram that the 1902 flood was only to a slight extent better than that of 1899. But the Halfa diagram shows a more decided advantage in favour of 1902; the cause of this disagreement in the comparison made from the readings of these two gauges is as yet unexplained.

CHAPTER III.

PUMPING STATIONS

MEX STATION.

The great increase in the quantity of water pumped at the Mex station, in the endeavour to keep the level of Lake Marcotis low, has been referred to in general terms in the first chapter of this Report. The continued increase is attributed to greater drainage facilities and the reclamation of lands which, instead of as formerly acting as evaporating areas, now add their drainage to the lake. Fortunately the price of coal has fallen, so that, in spite of the increase in the quantity pumped, the total expenditure is less than the year before. The average price of coal per ton was £E.1.286 in 1902; in 1901 it was £E.1.746.

The following tables of comparison give details about the present and past seasons.

WORK DONE AND COST.

SEASON.	Quantity pumped cubic metre.	Feet.	Rate per million cubic metres pumped.	Price of coal per ton.
	C.M.	FE.	FE.	FE.
1895-1896	175,078,166	1,588	13,000	
1896-1897	216,994,810	8,968	37,000	
1897-1898	227,429,530	8,675	38,000	
1898-1899	284,896,064	8,378	30,000	1.237
1899-1900	202,987,741	9,391	46,261	1.678
1900-1901	316,435,869	14,182	44,818	1.746
1901-1902	384,946,043	13,297	34,548	1.286

RAINFALL AND LAKE LEVELS.

SEASON.	Rainfall.	Maximum level of lake.	Date of maximum.	Minimum level in preceding summer.	Date of minimum.
1895-1896	10.45	—2.15	17th March.	—3.15	22nd August.
1896-1897	8.53	—2.03	7th January.	—2.92	11th Sept.
1897-1898	12.94	—2.17	23rd January & 13th March.	—3.20	27th August.
1898-1899	11.88	—1.95	18th Feb.	—3.26	16th Sept.
1899-1900	8.28	—2.29	27th Jan.	—3.29	11th August.
1900-1901	10.08	—2.18	19th Jan.	—3.23	17th August.
1901-1902	8.55	—2.31	4th January & 25th January.	—2.85	16th August.

The season's pumping began on 27th September 1901, about a month earlier than usual, and continued until 7th May 1902. As is seen in the above tables, the total cube lifted was 384,946,043 cubic metres, at a cost of £E.13,297. The mean height to which the water was lifted was 2.97 metres. The total quantity of coal consumed was 7,169 tons, at a rate of 18.625 tons per million cubic metres lifted.

The whole installation of 5 Farcoets and 2 Gwinnes worked together for six days in February. The maximum lifted in any one day of 24 hours was 3,278,520 cubic metres.

The pumping for the following season 1902-1903 was begun on 23rd September 1902. The Inspector of Irrigation reports that he expects the quantity pumped will exceed even that of the year before. In spite, however, of a heavy rainfall, the lake level has been kept lower than for many years past.

The actual expenditure of this station during 1902 was £E.14,400. This is made up of part of the expenditure of the two seasons 1901-1902 and 1902-1903.

ATFEH STATION.

The pumps were worked for 20 days during the summer to supplement the Mahmudia Canal supply. During this period 35,432,691 cubic metres were lifted.

This station, which had fallen into a state far removed from one of working order, is being renovated by the help of money granted by the Caisse. Six new large boilers of approved type have been procured, and three of them had already been put in place in time to use for the summer pumping. The engine and boiler houses are being roofed, the old roofing, where it existed, having completely corroded. The engines have been overhauled and important parts of the machinery renewed; the level of the wheels has been adjusted to suit the new conditions of working, and other improvements made. The expenditure on this work during 1902 was as given in the following abstract:—

	£E.
Roofing of boiler house No. 2... ..	873
Roofing of boiler house No. 1. and engine house	465
Three Galloway boilers	1,741
Spur wheel and pinion for Beam Engine D.	1,275
Total... ..	<u>£E.4,354</u>

The actual expenditure for the year is thus made up :—

	£E.
Improvements on station as above	4,354
Salaries and maintenance	450
Expenditure on working the station	1,012
Total... ..	<u>£E.5,816</u>

The expenditure on working the station does not include the cost of 473 tons of coal consumed, which was purchased the year before at £E.1.710 the ton.

CHAPTER IV.

THE DELTA BARRAGE AND ITS WEIRS, AND THE ZIFTA BARRAGE.

REGULATION.

The Barrages were both fully closed by 29th March, 1902, and an upstream level of R.L. 14.25 was obtained. The gates were then caulked to prevent any loss through leakage, and the level of R.L. 14.25 maintained till 4th April, after which date the level gradually fell till 22nd June, when the minimum level of R.L. 13.60 was reached. The real rise began on 7th July, and R.L. 15.50 was recorded on 30th July.

R.L. 15.50 is the level of the top of the gates as lately heightened. It had been laid down as the rule in the two preceding years that, after that level was reached there should be no further raising of the upstream level until all the Barrage gates were fully raised. In 1901 the operation of this rule brought it about that, after reaching R.L. 15.50, there was no further rise for a period of 29 days (22nd July to 19th August), during which it was found that this level gave canal discharges which were not wholly satisfying. Hence, after much consideration, it was decided to conduct the regulation in such a way that, after R.L. 15.50 had been reached upstream, the upstream level should continue to rise, but that for every centimetre of rise upstream the downstream level should be made to rise 4 centimetres in correspondence.

In consequence, the following levels were obtained in the dates named:—

10 August	...	...	...	15.65	23 September	16.27	maximum
20 "	...	...	...	15.76	10 October...	16.17	
30 "	...	...	...	15.96	20 "	...	16.23
10 September...	...	...	...	16.16	30 "	...	16.08
20 "	...	...	...	16.22	10 November	15.90	

Considerable benefit was felt to be the result of the improvement in the canal discharges thus brought about. The late rise of the flood was rendered scarcely noticeable in Lower Egypt and, except for the high sahels outside the Nile bank, the Delta felt no inconvenient effects from the lateness and lowness of the flood.

In 1899 the maximum level reached above the Barrage was R.L. 15.61 on 9th September; in 1902 the level reached was R.L. 16.27. In neither year was the Barrage over fully open. The better level of 1902 was due to the new programme of regulation and not to better conditions of flood.

No injury occurred to the Barrage through getting this extra work out of it. Constant soundings were made for the detection of any scour. The severest action appeared to take place when the Barrage was discharging under a head of from 1.20 to 1.50 metres. A depression of 1.64 metres maximum depth, about 20 metres long by 14 metres broad, was noticed to be gradually forming downstream of the left flank of the Damietta Branch Barrage opposite the openings which silt up annually. No doubt this was caused by a lateral eddy and not by direct scour. The hole, after detection, was filled up with about a hundred large stones of 1 to 1½ tons weight, and the action was thereby stopped with an expenditure of £E.43. There was no sign of erosion elsewhere.

The cost of working and maintaining the Barrage excluding the cost of all establishment and office charges and garden expenses was £E.6834. This sum does not include the cost of the asphalt brick paving, but merely works of maintenance proper, inclusive of £E.456 paid for stone collected as a reserve.

This does not include the expenditure on the training of the river above the Barrage, on which a further sum of £E.2672 was expended, £E.672 of which was the cost stone purchased at the end of the year for work in 1903.

The Hall for Irrigation Models was completed during 1902, but the flooring was condemned and is being relaid in 1903, so that the £E.960 expended in 1902 does not include the final payment. The expenditure to the end of 1902 on the building of has been £E.3125. The total cost of the finished building will probably not exceed £E.3200.

The hall contains at present nineteen models, of which the Delta Barrage and Weir models are perhaps the most interesting and instructive. The Upper Egypt Reservoirs are not yet represented in the Model Room, but it is hoped that they will be soon.

The wood-brick paving of the Barrage roadways having proved unsuitable, a commencement was made in 1901 to replace it by a paving of compressed asphalt bricks. Half of the Damietta Branch Barrage was paved with asphalt in 1901 at a cost of £E.1,319. The remaining half of this Barrage and the whole of the Rosetta Branch

Barrage was similarly paved in 1902 at a cost of £E.4,325, so that the total cost of paving the two Barrages has been £E.5,644. The work included doubling the trolley line and asphaltting the footpaths. The sum of £E.4,325, expended in 1902 on the Rosetta Branch Barrage paving, was made up of £E.3,630 specially granted from Reserve and of £E.695 added from the usual Barrage allotment for maintenance.

The roadways of the Tewfiki and Menufia Heads were paved in the same manner in 1900, and the Rayyah Behera Head has, during 1902, also been given an asphalt brick paving, so that the work of paving the Barrage and its three canal heads is now complete.

The upkeep of the gardens was provided for by a grant of £E.800 from the maintenance allotment of the Barrage and by the receipts for sale of fruit and other garden produce which contributed a further sum of £E.969. Besides this expenditure, £E.250 was devoted to the extension of the gardens to join up with the Rosetta Branch, and £E.250 more for arranging the grounds in front of and around the Model Room. These two sums of £E.250 were charged against the maintenance allotment.

As the Barrages and their weirs are now complete, the Budget allotment for maintenance has been reduced in the 1903 Budget by a further sum of £E.2,000, which, with the 1902 reduction of £E.1,225, makes a total reduction on the figure of Budgets previous to 1902 of £E.3,225; that is the figure of £E.13,225 of former years, allotted for maintenance and repairs including river training, has been reduced to £E.10,000, which is considered to be fully sufficient for the Barrage in its present condition of completion.

The alterations of the Rayyah Behera Head, though a Barrage work, will, as last year, be referred to in the chapter which deals with Irrigation Improvements, as it was carried out with special grants. So also will the Nigail (West Nili) Canal.

WEIRS.

The weirs throughout the summer held up their two or three metres efficiently.

When the Barrage gates had been closed in the spring and it was possible to examine the weirs, it was found that nothing had moved in the east weir on the Damietta Branch. But downstream of the west weir on the Rosetta Branch a deep hole, with its deepest point at R.L. 0.50, had been scoured out opposite the east compartment ;

and a second hole of two metres less depth (to R.L. 2.50) was found downstream of the west compartment near the lock. The latter hole was altogether beyond the heavy stone apron, which it had not disturbed. But the former hole had engulfed half the width of this apron for a length of 20 to 30 metres. The lowest point of the mass forming the weir is the base of the core-wall, which is at R.L. 4.00; so that the bottom of both holes was below the lowest masonry of the of the weir.

The existence of the holes and their extent having been determined, orders were given to fill them up below with any kind of stone left over from the weir materials of construction, and to cover the small stuff with four metres' depth of the heavy apron blocks of which a reserve existed. The filling of the deep east hole up to R.L. 10.00 (which is the level of the top of the fortifying wall), took 2,200 cubic metres of rubble and broken stuff, and 1,350 cubic metres of heavy apron blocks; the hole at the west end took 710 cubic metres of rubble and 685 cubic metres of big blocks. The cost of putting the material in place was £E.354. The east hole was probably caused by an eddy set up by the projecting point, some two hundred metres upstream of the weir, where there was a mass of masonry which was connected in some way with the old fortifications. This has now in part been demolished and removed, but it may require to be still further cut back before it ceases to create eddies.

The west hole was probably the consequence of eddies produced at the end of the lock wall where the discharge over the weir meets still water.

It will be necessary yearly to fill up any such holes as may scour out, until there is such a talus formed to the weir that the bed is efficiently protected from all scouring action. The East Weir shows no sign of being ever likely to require any repairs or additions on account of down-stream scour, and I do not expect that the West Weir is likely to require much. But all holes that may be found to have formed beyond the downstream apron must be conscientiously filled up and covered with heavy stone, and if this is done, the weirs should last, humanly speaking, for ever.

There was expended during the year on the Weirs a sum of £E.2,235, bringing the total and final cost of the two Weirs up to £E.434,000.

The details of the expenditure during 1902 is made up as follows:—

	££
Huts for Lock keepers	208
Levelling up land from which clay was obtained	238
Levelling stacking grounds of E. Weir... ..	179
Shaping bank above W. Weir... ..	217
Purchase of rubble stone	150
Filling holes scoured out below W. Weir	354
Collecting plant into store, repair of trolley lines, removal of masonry projection above W. Weir, and tree plantation ...	587
Total... ..	<u>££2,235</u>

ZIFTA BARRAGE.

The object of this work was explained in last year's Report and a description given of the work itself. The portion of the foundations and superstructure constructed in 1901 served in the following season as a passage for the river discharge, and enabled the whole of the rest of the work to be taken in hand in one operation. The banks, enclosing the area of the foundations yet to be laid, were closed on 2nd January 1902. A bridge to carry the Light Railway across the waterway was made and the lines on both sides of the river were connected across it.

With commendable foresight Mr. Hurley had had four pump wells sunk the previous season ready to receive the pumps for the second season's work, so that there was a minimum of delay in getting the pumps to work. All four were at work by the 27th January. On 7th February the first cast-iron pile of the second season was driven; six pile-engines were at work by 16th February, and the whole of the piling was complete by 8th March, the total driven during these four weeks being 303 lineal metres of sixteen-feet piling and 411 metres of ten feet piling. As the foundations of the east abutment proved to be to a great extent running sand, the piling was carried all round the back of it to connect the upstream and downstream lines of piling running the whole length of the Barrage.

The operation of laying the concrete commenced on 24th February from the west end and a week later from the east end. The concrete was made of five parts of broken stone, three of sand and one of cement. The concrete was finished on 29th March, the cube executed being 8,258 cubic metres.

There were but few springs met with and those few were not formidable. The strongest springs were outside the work on the upstream side where they did not interfere with the work. A layer of clay below foundation level, overlying the sand, kept the springs from rising. It was only towards the east end of the Barrage and under the abutment



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ZIFTA BARRAGE.

that the sand was reached. The floor throughout was a thoroughly sound piece of masonry without a defect, all springs having been skilfully dealt with and subdued.

While the concrete was being laid, the lock walls and piers of the previous season were being leisurely raised, and the rubble masonry layer over the concrete foundations was following the advance of the concrete. The floor was complete on 4th May, the total cube of rubble masonry in it being 17,424 cubic metres. The piers rose quickly upon the floor and by the end of July were all up to the level of the springing of the arches (R. L. 12.00), and the lock and east abutment were a metre lower.

The clay aprons, filter bed, and up and down-stream pitching followed along as the floor was completed, and the following cubes were executed:—

	cubic metres.									
Clay apron	7,678
Filter bed	3,307
Pitching	25,068

On 31st July the containing banks were cut and the river discharge allowed to pass over the new season's work.

Most satisfactory progress was made throughout the season in consequence of the excellent arrangements made by Mr. Hurley for the transport of materials, chiefly through the agency of the Light Railway Company. The manner in which this transport and the whole work was organised reflects great credit on the Resident Engineer and shows that he has great powers in this direction.

The supply and erection of the ironwork, for which Mr. Hurley was not responsible, as it was given out to contract to two Belgian firms, was not so satisfactory. The grooves of the Barrage were very coarse castings and required a good deal of work on them, after arrival at site, to make them serviceable. The ironwork of the regulating gates is not first class quality, but is sufficiently strong, though wanting in finish.

But the most unsatisfactory of all were the lock-gates, of which the workmanship of the iron was so inferior that much trouble was experienced in putting the pieces together and erecting the gates. Neither an examination of the ironwork as it came from Europe, nor the manner of putting it together and erecting it on the spot produced anything but dissatisfaction. Not only was the workmanship defective, but the supply was late, and the lock had to be enclosed by earth dams till 16th August to enable the gates to be put together and erected.

The masonry of the Barrage and lock was continued during flood, the first arch having been started on 31st July. All the arches were

turned by 20th September and the regulator gates slung into their grooves by 22nd October. By the end of 1902 the Barrage was complete with the exception of the ashlar parapets, which were delayed by a failure in the ashlar supply. The total cube of brick-work executed was 25,817 cubic metres.

The following shows the quantities of work done in the two seasons:—

	1901	1902	Total.
16 feet piling	202	303	535
10 feet piling	116	411	527
Concrete in cement	5,328	8,258	13,586
Rubble masonry in cement	13,000	17,421	30,421
Dry rubble work	5,410	25,068	30,478
Clay-puddle	2,276	7,678	9,954
Filter bed	583	3,307	3,890
Brick masonry	246	27,188	27,434
Ashlar masonry	81	2,945	3,026
Ironwork	16	1,044	1,060
Earthwork	262,933	519,688	782,621

The expenditure of the seasons under different heads is given below:—

	1901	1902	Total.
	£R.	£R.	£R.
Establishment	3,076	4,098	7,174
Houses	6,638	1,598	8,236
Land	1,729	1,581	3,310
Sundries	527	824	1,351
Plant	497	6,071	6,568
Labour	20,739	37,261	58,000
Earthwork	7,518	11,946	19,464
Timber, coal and stores	6,829	25,691	32,520
Ironwork	12,515	16,725	29,240
Purchase of materials	55,344	19,812	75,156
Transport	5,637	15,984	21,621
Totals £R.	121,059	144,591	265,650

Considering that it was on 27th December 1900, that the grant for this Barrage was first communicated, it is no mean feat to have practically completed this fine work by 27th December 1902. The decision, taken after the first season's work, to allow Mr. Hurley to remain in charge of the operations as Resident Engineer has been



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ZIFFT BARRAGE, WEST END.

fully justified by the result. The staff who have helped him to build this work and who have carried out their duties creditably are Mr. L. N. Cooper, Mr. W.W. Grant and Mr. R.A. Colvin. The accounts were kept in a satisfactory way by Mr. E. Mahfoud.

During the first season's work the plague visited Zifta and the neighbouring villages, and carried off some of the workmen. Special hospital arrangements had to be made and sanitary regulations enforced, but the work went steadily on. Before the second season was over cholera came on the work, as generally elsewhere in Egypt. Among the victims claimed was one of Mr. Hurley's servants. During the first season also one of the English staff of Engineers committed suicide soon after his engagement. But in spite of these drawbacks the work never slackened, though the difficulties of administration were increased. Work on the first projected Egyptian Barrage of all, that was commenced by Linant Bey in 1833, was stopped by the plague of 1835 and was never afterwards resumed.

In connection with the Zifta Barrage a number of subsidiary works have to be built to connect the canal systems on either side of the river with the reach upstream of the Barrage. The following is a list of the works that were taken in hand during 1902, with the year's expenditure on them.

WEST OF THE RIVER—2ND CIRCLE.

<i>Earthwork—Zifta Canal:</i>							£E.
Land purchase and excavation	...	...	...	...	...	...	12,831
<i>Masonry works on Zifta Canal :</i>							
Zifta Canal Head	...	...	...	...	...	...	37,612
Omar Bey Canal Syphon	...	...	...	...	...	...	2,956
Drain Syphon at 6th Kilometre	...	...	...	...	...	...	1,374
Bahr Shirshaba Escape...	...	...	...	...	...	...	1,253
Bahr Shirshaba Syphon...	...	...	...	...	...	...	2,147
Drain Syphon in 9th Kilometre	...	...	...	...	...	...	828

EAST OF THE RIVER—2ND CIRCLE.

Mansuria Canal Head	...	...	...	...	...	...	5,489
Total...	...	...	...	...	...	...	£E.64,490

The earthwork of Zifta Canal * was given out in contract to Luca Liutich in August, and by the end of the year was well advanced and

(*) At the inauguration of the Zifta Barrage and this Canal by H.H. the Khedive on 7th March 1903, the Canal was renamed by His Highness after himself "the Rayyah Abdim."

progressing satisfactorily. It runs for ten kilometres on a straight line from the river to Bahr Shubin with bed a width of 25 metres and an average depth of 4 metres below soil. The cube executed by the end of year was close on a million cubic metres.

The Zifta Canal Head is the most important of the masonry works on this canal. It has been given four openings of five metres each, and a lock 8 metres broad and 35 metres between corresponding gates. The lock has a double set of gates to resist a head from the canal side. The regulating portion of the Head is also designed to withstand a reverse pressure. The design is similar to that of the Zifta Barrage in foundation and superstructure; but as the foundations were in good stiff clay, it was decided to suppress the downstream row of piles and to put a line upstream only. This line was carried along the front of the regulator and round the upstream end of the lock in an unbroken line, and continued at both ends well under the position of the side slopes of the approach channel.

Excavation for the foundations was begun on 2nd April 1902 and finished on 17th May, when the first pile was driven. The piling was finished on 5th June.

Concreting began on 26th May and finished on 18th June, the total cube laid being 3,316 cubic metres. The concrete was of homra and lime, and not of cement as in the Zifta Barrage.

The masonry of the floor over the concrete was begun on 2nd June and was completed on 15th July. Its cube was 4,600 cubic metres.

The superstructure was not commenced until 15th August on account of the failure of the brick contractor to supply bricks in sufficient quantity.

By the end of the year all the arches were turned and the lock was up to coping level.

The quantities of work done to the end of the year were:—

16 feet piling	lineal metres...	137
Concrete	cubic metres...	3,316
Rubble masonry	" "	4,600
Ashlar masonry... ..	" "	150
Brick masonry	" "	8,230
Ironwork	" Tons...	225
Earthwork	cubic metres...	118,634

The total quantities of work done in the other masonry works named above were:—

Concrete... ..	cubic metres...	1,321
Brick masonry	" "	463
Dry rubble masonry	" "	380
Ironwork	" Tons...	297
Earthwork	cubic metres...	64,570



Sur. Dept. P. W. S.

ZETTA BARRAGE LOCK.

The Zifta Barrage subsidiary works mentioned above were all carried out under the direction of Mr. Hurley with the assistance of the same staff that he had under his orders for the building of the Zifta Barrage itself.

In addition to the expenditure by the Zifta Barrage Direction, a further sum of £E.3,168 was expended by the Inspector of Irrigation of the Ist Circle on subsidiary works in the Dakahlia Province, this expenditure being charged to the Regular Budget. The work done consisted of earthwork, collection of materials and purchase of iron pipes for syphons. This preliminary work it was necessary to execute in advance, so that the period of winter closure of canals might be taken advantage of for getting in the iron pipe syphons without the necessity of making costly diversions of the Mansuria and Um-Salama Canals. The object of the syphons and the connecting channels is to carry the high level water of the Delta Barrage system under the canals which will be fed from the river above the Zifta Barrage, so that those lands, which are too high to be commanded by the levels due to regulation on the Zifta Barrage, may be in connection with the high level water of the tail of the Delta Barrage system. The syphons were successfully constructed during the closure, but as the construction and expenditure fell in 1903, the account of them will be left for next year's Report.

The group of subsidiary works, being carried out under Mr. Langley's direction, includes also a junction canal and the masonry works on it designed to connect the lower Buhia with the Um-Salama, so that the former may be fed, when desirable, from the river supply above the Zifta Barrage by way of the Um-Salama Canal. These works are also being built in 1903.

CHAPTER V.

NEW WORKS OF IRRIGATION AND DRAINAGE.

As was done in the two preceding Annual Reports, a statement of actual expenditure is given below, in which the figures represent more correctly the objects of expenditure than does the Abstract of Expenditure, Appendix A, made out according to the Budget Heads to which the expenditure has been charged in the accounts. The Wadi Tumilat expenditure alone is omitted, as it is dealt with separately in Chap. VIII.

ABSTRACT OF EXPENDITURE ACCORDING TO ACTUAL OBJECTS ON WHICH EXPENDITURE WAS INCURRED.

Chapter of report.	HEADS OF EXPENDITURE.	1st Circle.	2nd Circle.	3rd Circle.	Delta Barrage, Direc- torate.	Zifta Barrage.	TOTAL.
		£E.	£K.	£E.	£E.	£E.	£E.
	<i>Establishment.</i>						
	Pay of classified staff	9,191	8,877	6,859	2,526	—	27,453
	Pay of unclassified staff, offices, instruments, travelling allowances, telegrams and dahabias	12,837	12,129	8,853	5,411	4,008	42,831
	<i>Works.</i>						
Chap. I.	River temporary dams	4,568	—	9,644	—	—	14,212
Chap. III.	Pumping stations, including staff ..	—	—	20,216	—	—	20,216
Chap. IV.	Weirs below the Delta Barrage ..	—	—	—	2,285	—	2,285
"	Zifta Barrage and subsidiary work ..	3,168	—	—	—	204,983	208,151
Chap. V.	Irrigation Improvements: Large masonry works	28,925	6,113	4,829	22,945	—	62,812
"	Irrigation Improvements: Earth- work and smaller masonry works ..	8,042	25,496	20,984	8,555	—	63,077
"	New drainage works	21,961	19,611	23,647	—	—	64,622
Chap. VI.	Protective works	5,727	16,294	10,454	6,094	—	38,769
Ch. VI & IV	Maintenance: Masonry and buildings ..	4,160	3,968	2,733	7,394	—	18,255
Chap. IV.	" Gardens & tree planting	—	67	—	2,260	48	2,375
Chap. VI.	" Earthwork	43,696	60,193	22,028	9,032	—	135,149
"	" Drudging	26,172	5,740	7,800	—	—	39,712
Chap. VII.	New roads, including staff	325	11,491	56	—	—	11,872
"	Roads: Maintenance	1,400	953	500	—	—	2,853
"	Ferry and bridges	2,097	156	1,000	—	—	3,763
Ch. I, II & VI.	Special expenditure on account of low river levels	779	576	1,895	788	—	4,032
Chap. VI.	Special expenditure on account of cholera	328	—	—	—	—	328
"	Special works: El-Batal Bagg Reservoir ..	5,296	—	—	—	—	5,296
"	" Survey Nubarin Canal	—	—	881	—	—	881
Chap. IV.	" Asphalt brick paving	—	—	—	4,325	—	4,325
"	" Model Room	—	—	—	960	—	960
	Sundries	1,035	—	(Paid from Assyl)	714	—	3,494
				1,745			
	Totals £E.	180,791	171,649	183,724	74,142	206,129	

NOTE.—The difference between these totals and those of Appendix A are due to the inclusion in this statement of expenditure against sums derived from Delta Barrage Garden Fund, sale of old materials, recoveries on account of damage done to works and contribution by Alexandria Municipality.

The river temporary dams have been dealt with in Chapter I, and the pumping stations in Chapter III; excepting the Kassassin pumping station, the figures for which are not included in this statement, as they are given in Chapter VIII which is devoted to the Wadi Tumilat.

Work in connection with the Delta Barrage and Zifta Barrage will be found described in Chapter IV. This Chapter V deals with the new and remodelled works of irrigation and drainage for which special allotments were made either by the Caisse de la Dette, or by the Under Secretary from the Reserves of the Public Works Budget.

IRRIGATION IMPROVEMENTS.

Large Masonry Works.

The works included under the head of "Large Masonry Works" are the following:—

CIRCLES.	NAME OF WORK.	Expenditure during 1902 £ E.	Total for Circle. £ E.
1st Circle ...	Ismailia Canal Head	23,239	28,985
	Siriakus Additions	5,686	
2nd Circle	Dimera Lock & Regulator	6,113	6,113
3rd Circle	Zulficar Bridge, Alexandria... ..	4,829	4,829
Delta Barrage	Rayyah Behera Head	13,912	22,945
	Nikla Lock and Regulator	9,033	
			62,812

The allotments for carrying out these works were the ordinary Budget allotments for maintenance; and special allotments granted by the Caisse de la Dette, and the Public Works Ministry from its own Reserve, to be devoted to new works irrigation, improvements and drainage, as well as for other special objects.

The Caisse grants made in 1902 to Lower Egypt were as follows:—

	£E.
Irrigation Improvements	92,000
Drainage Works	48,200
Zifta Barrage	250,000
Sadd Rosetta Branch	9,000
Sadd Damietta Branch... ..	5,000
Special Low Summer Nile Credit.. ..	11,000
Special Low Flood Credit	3,000
Suppression Bulagha Canal (cholera prevention)	2,000
Ezbet El Borg Reservoir.. ..	7,697
Total	<u>£E.427,897</u>

The unspent balances of the previous year were added to these sums and the amounts were modified during the year as shown in the accompanying statement, which also shows the year's expenditure against these grants and the balances unspent at the end of 1902.

The above Caisse allotments were supplemented by special grants from the Public Works Ministry's own Reserve as below :—

	Original allotments 1902.	Modified Allotments.
IRRIGATION IMPROVEMENTS.		
1st Circle	20,000	11,475
2nd Circle	3,000	3,000
3rd Circle	8,700	10,402
Barrage Directorate	21,480	21,480
Totals... ..	53,180	46,357
DRAINAGE.		
1st Circle	500	500
2nd Circle	8,000	—
3rd Circle	5,000	1,298
	13,500	1,798
PROJECTS.		
<i>Nubaria Development.</i>		
3rd Circle	881	881

CAISSE CREDITS, 1902.

	Balance from 1901.		Original allotment, 1902.		Total.		Modified.		Expenditure.		Balance to carry forward.	
	£E.	ML.	£E.	ML.	£E.	ML.	£E.	ML.	£E.	ML.	£E.	ML.
<i>Irrigation Improvements.</i>												
1st Circle.. .. .	10,046,149		25,500,000		35,546,149		40,546,149		31,447,267		4,098,882	
2nd Circle	6,318,794		30,200,000		36,518,794		36,518,794		32,591,003		3,927,791	
3rd Circle	1,825,171		20,000,000		21,825,171		21,825,171		19,434,459		2,390,712	
Delta Barrage.. .. .	3,540,794		16,300,000		19,840,794		19,840,794		15,194,007		4,646,787	
Totals.. .. .	21,730,908		92,000,000		113,730,908		118,730,908		98,666,826		20,064,082	
<i>Drainage.</i>												
1st Circle.. .. .	12,426,271		14,500,000		26,926,271		26,926,271		23,119,216		3,807,055	
2nd Circle	6,085,684		15,500,000		21,585,684		21,585,684		23,601,515		5,014,169	
3rd Circle	2,508,290		18,200,000		20,708,290		22,708,290		21,826,261		882,029	
Totals.. .. .	21,014,245		48,200,000		69,214,245		71,214,245		68,546,992		10,667,253	
Zifta Barrage	8,910,662		250,000,000		258,910,662		258,910,662		209,081,132		49,829,530	
Sudd, Rosetta Branch	—		9,000,000		9,000,000		9,000,000		9,000,000		—	
Sudd, Damietta Branch. ..	—		5,000,000		5,000,000		5,000,000		4,568,694		431,306	
Totals.. .. .	—		14,000,000		14,000,000		14,000,000		13,568,694		431,306	
New Weirs	2,235,399		—		2,235,399		2,235,399		2,235,195		200	
<i>Special Low Nile credit.</i>												
1st Circle.. .. .	—		800,000		800,000		750,000		645,800		154,200	
2nd Circle.. .. .	—		900,000		900,000		750,000		569,772		130,228	
3rd Circle.. .. .	—		800,000		800,000		950,000		921,484		78,516	
3rd Circle (Atfeh Pumps) ..	2,998,925		7,500,000		10,498,925		10,498,925		5,826,332		4,672,593	
3rd Circle (Rosetta Sudd) ..	—		1,000,000		1,000,000		1,000,000		644,116		355,884	
Barrage	—		—		—		50,000		38,122		11,878	
Totals.. .. .	2,998,925		11,000,000		13,998,925		13,998,925		8,655,735		5,343,190	
<i>Special Low Flood credit.</i>												
1st Circle.. .. .	—		250,000		250,000		250,000		136,440		113,560	
2nd Circle	—		750,000		750,000		750,000		—		750,000	
3rd Circle	—		1,250,000		1,250,000		1,250,000		973,740		276,260	
Barrage	—		750,000		750,000		750,000		750,000		—	
Totals.. .. .	—		3,000,000		3,000,000		3,000,000		1,857,180		1,142,820	
Bahigia Canal	—		2,000,000		2,000,000		2,000,000		227,784		1,772,216	
Exbet el Borg Reservoir. ..	59,167		7,697,000		7,756,167		7,756,167		5,236,236		2,519,931	

The sums, which were available for expenditure, were, of course, the modified allotments.

WORKS IN 1ST CIRCLE.

The Ismailia Canal New Head was begun in 1901 and the operations of the first season were described in that year's Report. On account of the difficult nature of the foundations, it had been decided to get in the platform of the Ismailia Canal Head by well-sinking combined with the cement-grouting method. The wells had been sunk and filled with concrete in the 1901 season. The whole area of the foundations was surrounded by rectangular wells, in addition to which circular wells were sunk under the part of the lock island which did not rest on the boundary wells, and also under the four wing walls.

When the water in the foundation pit was pumped out at the commencement of the 1902 season, it was found that the downstream row of wells had been very unevenly sunk, and that the wells under the lock abutment were also much out of plumb: also that the core-filling of the wells had been so badly done that springs rose up through the concrete in most of the wells. The Engineer in immediate charge had had very definite instructions as to how he should form the plug at the bottom of the wells by grouting, but he had not followed them. In spite of explicit cautions to produce still water before attempting to grout, he attempted grouting where springs were working, with the inevitable result that the springs forced and kept open a passage for themselves through the grout. Although the plug was not made staunch, still the concrete was placed on the top of it, and so inefficiently was the work done that the springs rose through the concrete to the top of the wells, every one of these passages for springs had to be stopped afterwards by opening them out and subjecting them to a head of cement grout. The carelessness with which the work was carried on at the end of the first season's work, resulted in increased expenditure of money, time and labour during the second season.

It may be noted here, before proceeding to describe the second season's work, that the progress of the work at all stages suffered seriously from a lamentable want of organisation, and to the over-estimate formed of the competency of the selected engineer of the temporary staff of the 1st Circle who was recommended as fit to have charge of the work. The work was one of such difficulty and importance that a competent Resident Engineer was a necessity. It is, however, a matter for congratulation that, in spite of the mistakes made during the first season and the slow progress of the early part of the second season, a satisfactory final result has been obtained. The foundations have been made a thoroughly sound job; and were got in

soon enough to enable the superstructure to be raised upon them as high as the springing of the arches before work was stopped for the flood season.

The 1902 season's work, after the flood of 1901, began by pumping out the foundation pit and excavating for the floor. At the same time piles, made of half-inch steel plate stiffened with T irons, were driven outside the boundary wells to close the intervals, and so prevent the earth on the outside from being drawn through the intervals when dredging should be undertaken to clear the space enclosed by the wells down to foundation level. It took 62 days to drive 42 piles.

As springs were rising over the whole area of the foundations through fine black sand at one to two metres above foundation level, and as previous experience had shown how difficult it was to build sound work on such a substratum with springs rising through it everywhere, it was decided to get in the floor platform all over the area bounded by the wells by the cement-grouting method, successfully employed before for getting in the foundations of the two Barrage Weir Locks, and of the new portion of the Rayyah Behera Head. The programme, which was followed, was, first of all, (after closing the intervals between the wells by iron piling) to build the "saddle-back" and rubble pitching upstream of the regulator and lock and along the side of the lock above the regulator floor; and also to build up the wing walls to a considerable height above the finished level of the floor. This having been done, the river dam was cut and the water allowed to rise in the pit till it became stationary. A sand dredger was then admitted through the opening in the dam, and the foundations were dredged out to the required level of R.L. 8.00. (Actually the floor was dredged in places to 7.70.) Some difficulty was experienced in getting the intervals between the wells clear to the desired depth but, by various expedients, the clearance was in the end successfully effected. The dredger, having done its work, made its exit by the opening through which it entered, and the grouting pipes and staging were then arranged all over the foundation area. As soon as the pipes were in place, rubble was thrown in round them to the required height, that is to R.L. 9.50. Grouting was then carried on according to the system described in previous reports on the construction of the Weir locks. Grouting began on the morning of 16th June and continued for 5 1/2 days till the evening of 21st June. The opening through the river dam was then closed and the work left undisturbed till the morning of 24th June, when pumps were set to work to lower the water in the enclosed foundation pit. When, after three days' pumping,

the surface of the grouted platform had been laid dry and cleaned, it was found that the operation had been successful, and that the only leaks were through the faulty wells. These leaks were subsequently easily closed.

When the work had reached the stage at which preparation for the grouting operations had to be taken in hand, with Mr. F. R. Stent, with Mr. C. S. Boyes to help him, was put in charge of the work, as their experience on similar work at the Delta Barrage specially fitted them for the carrying out of this work. After Mr. Stent took charge, the work went well, though still delayed from time to time in consequence of the want of organisation before referred to. The grouting operation was delayed for want of sufficient rubble, and the subsequent construction of the superstructure for the want of portions of the iron-work.

Altogether 7,097 barrels of cement were expended to form 2,554 cubic metres of masonry, which gives 2.78 barrels to the cubic metre, a short allowance compared with the results on the weirs. I suspect that the quantity of grouted masonry was somewhat less than that given. Mr. Langley estimates the cost per cubic metre as £E.2.249. This is less than the grouted masonry of the weirs cost, but the lower price paid for the cement at Shubra accounts for the difference.

There is a detail worth describing connected with the closing of the well-intervals. It was considered desirable to obtain a continuous water-tight curtain-wall to the full depth of the wells (R.L. 5.00) along the whole length of the upstream face of the work. The sheet-iron piles, though flexible to a certain extent, could not be expected to lie so close against the masonry of the wells as to produce a water-tight joint. So, in order to close the joints between the piles and the wells, a pair of pipes was sunk in the well intervals, each pipe lying in the angle formed by the pile and the face of the well wall. The length of pipe below the floor foundation level was perforated, and the pipe was so placed that the perforations faced the angle. The pipes were sunk by means of a jet of water playing on the sand at the foot of the pipe from inside the pipe itself. When sunk to the required depth, the pipes were filled with sand to provide for the exclusion of cement-grout when grouting the floor. After the floor had been grouted and laid dry by pumping, the staunching pipes were cleared of sand by means of a jet of water, and were then filled with grout. It was found in every case that the two pipes of a pair were in connection below the grouted platform in which their upper ends were embedded, as the grout, poured down one pipe, rose in the other, each pair of pipes taking about three barrels of cement to fill them. The fact observed that these pipes were

A similar work has been designed for providing additional waterway for the Billbeis Regulator, but it has not yet been taken in hand for want of funds.

WORKS IN 2ND CIRCLE.

Dimera Regulator and Lock.

The construction of Dimera Lock, of 21 metres by 6 metres, chamber, and the remodelling of the old Dimera Regulator, for which materials had been collected in 1901, was completed in 1902 at a total cost of £E.8,013, of which £E.6,113 was expended in 1902. The old regulator, being unassociated with a lock, formed a barrier to navigation which has now been removed by the new construction. This work is in the Gharbia Province. It was satisfactorily executed under Mr. Tottenham's direction with Mr. Baychelier in immediate charge.

WORKS IN 3RD CIRCLE.

Mahmudia Canal Bridges in Alexandria.

In 1901 the " Pont des Ecluses " had been renewed at a cost of £E.3,250. In 1902 the Zulficar Bridge, opposite Gabbares Railway Station, was likewise renewed at a cost of £E.4,829.

WORKS IN THE DELTA BARRAGE DIRECTORATE.

The Rayyah Behera Head was the last of the regulating works at the Delta Barrage remaining to be remodelled. The work of remodelling consisted in adding to the old work a new portion made up of a lock and two sluice-ways, and in diverting the old lock into two sluice-ways by the construction of a central pier. Sills were also to be built in the three bays of the old regulator, and all the seven bays fitted with iron grooves and gates to be actuated by an overhead winch. The lock had to be provided with a third pair of gates to resist pressure from the canal side during the discharge of Iswid Basin when the water level in the canal rises higher than the river. The gates of the regulating bays had also to be designed to resist pressure from either side. Mr. Stent worked out a design for these, which is ingenious and has been found suitable.

During 1901, as was described in the Irrigation Report for that year, the difficult undertaking of adding the new portion, close up against the old work, was successfully accomplished by employing the cement-

grouting method for getting in the foundations. The work was carried up to R. L. 16.00, and stopped when that level was reached early in the flood.

Work was resumed on the 16th December 1901, and the new lock and additional bays were completed by the 12th April 1902, including the lock gates and gear. While the lock gates were being put together in the early part of the year, the old masonry revetment of the original channel was removed down to R.L. 11.50—the level of the lock sill—with the object of clearing the navigable channel above and below the lock. The downstream revetment was demolished and removed in January by hand and blasting, the water level in the canal being lowered for the purpose to the extent required. During the short period required for this demolition, the Behera Province was given its water supply through the new Head at Khatatbeh, an arrangement which would not have been possible, had this Head not been constructed the year before.

The demolition upstream of the lock was not so simple a matter, as it had to be cleared to a depth of $2\frac{1}{2}$ metres below water-level. The length of revetment to be removed was 75 metres, and its sectional area was 8 square metres. The demolition was effected by tonite and the debris was removed by a grab dredger. Four-inch diameter holes at intervals of two metres were jumped in the masonry to the required depth. In these holes were placed 3 inch tubes of $3\frac{1}{2}$ ins. diameter and $3\frac{1}{2}$ metres length, the bottoms of the tubes being closed and their tops being clear above water-level. These tubes received the charges of tonite and the sand tamping. The charges were fired by electricity in groups of from 6 to 12 at a time, the placing and firing being carried out by parties of Royal Engineers of the Army of Occupation.

Meantime the systematic application of cement-grouting to the foundations by bores through the floor, with the object of correcting any defect that might remain after the construction of the floor, was completed over those areas which had not been treated the previous season.

One operation more remained to be carried out before the canal supply was diverted through the new lock and waterways to enable work to be undertaken on the old work. When the water had been lowered to remove the downstream revetment wall, some strong springs were found to be working along the line of sheet piling downstream of the lock, which had been driven along the downstream wing wall and the edge of the lock floor to connect up with the well on which the pump worked. These springs were prevented from working, while the lock gates were being put together and hung, by a dam of clay made over the tops of the piles. It was considered desirable, if possible, to close the intervals

between the piles which served as upward runs for these springs. The clay was, therefore, removed down to the piling and a trench formed for about 3 metres' length at a time, and 3-inch diameter iron pipes placed vertically at intervals of about two metres alongside the piles wherever a spring was found. The end of the pipe was buried in concrete metal to prevent its becoming closed with the earth, which was then replaced round the pipe, confining the spring to the pipes. When pipes were in position all along the line of piling and the springs had been imprisoned by refilling the trench made for the placing of the pipes, cement grout was poured down the pipes in succession until eleven barrels of cement had been used up. The cement was found to travel horizontally from below one pipe to the next; and also to be confined, as, when one pipe was being grouted, the water level in the next pipe rose to one metre above the water level in the canal outside; and the grout also forced its way upwards through the overlying dam when the head of cement grout produced a pressure which the clay covering was unable to resist. It was found later on, when the work was laid dry in January 1903, that this operation had been quite successful and that the springs had been stopped, so that a solid curtain wall of sheet piling with the interstices filled with cement has probably been formed.

At it now remained to execute the alterations to old work, the canal discharge was turned through the new portion, and the dams to close off the old work commenced on 3rd May. It was intended to enclose both the old lock and the three regulating bays together, and to carry on the alterations to both simultaneously. But it was found that the waterway of the newly built portion was insufficient to allow of this being done, and the old lock and regulating bays had to be taken in hand separately. This not only made the work more difficult, but practically doubled the length of time necessary for its accomplishment. As it was of the utmost importance that the work should be complete before the flood season, electric light was fitted up, and all work, except masonry, went on continuously by day and night. The chief difficulty in connection with the work on the regulator bays was the lack of space to work in, as the enclosing dam had to be formed inside the line of the old lock island wall and the old west abutment wall, the slopes of the up and downstream sadds practically meeting in the centre of the archways. As soon as attempts were made to clear a space to get in the new stepped cutwaters of the piers, the upstream dam, which was holding up a head of 4 metres, commenced to slip badly, so that each cutwater had to be taken in hand separately, the space for it being enclosed by an iron frame work with plates driven through the toe of

the dam to the floor to support it and enable the necessary space to be cleared of earth.

By the 10th June the sills in the regulating bays were complete and the pier additions built to above water level, so that the dams could be cut and the work in the old lock proceeded with. The necessary demolition, and the construction of sills and pier in the old work below water level was complete by 25th June, when pumping was stopped and the dams cut.

By the end of July all the masonry had been finished, the regulating gates put in place and the winch erected, so that the remodelled Head was in working order in time for the rising flood.

The only work now remaining to be done was a filter bed, downstream of the new part, and a small amount of demolition and construction upstream at the junction between the old and the new portions of the Head, as well as some revetting to slopes. This it had been decided to do after the flood, when, in order to have a thorough examination of the whole work, it was arranged to close off the Rayyah Behera by an earth saddle at its intake from the Nile, while the river was still high enough to give the Behera Province all water it wanted by feeding the Rayyah through the Khatatleh Head. When the work was thus laid dry, all that remained to be done was completed and a thorough examination made of the floor. It was found that the floor of both portions, old and new, was absolutely sound, after having stood the maximum head in both directions to which it is ever likely to be subjected; and that the springs which found their way up in the intervals between the piling had been staunch. The system adopted a few years ago on the Delta Barrage itself, of strengthening the foundations by cement-grout, was applied freely to the old portions of this Head wherever anything defective was detected or even suspected.

There is little doubt that the final result is satisfactory. The work was a most difficult one, and the ultimate success is mainly due to the energy and devotion applied to it by Mr. J. H. Grieve who was throughout in immediate charge of it.

The amount expended on this work during 1902 was £E.13,912 (Regular Budget £E.3,522, Caisse £E.10,390).

The total cost of the work, including the estimated expenditure of 1903 which will complete the work, is given by the following figures:—

Expenditure	1900	5,029
"	1901	20,643
"	1902	13,912
Estimated Expenditure.	1903	800
Total		<u>£E.40,384</u>

NIKLA REGULATOR AND LOCK.

The object of the Nikla Regulator was explained in the 1901 Report. The masonry was practically finished in 1901, but there remained for 1902 the putting together and hanging of the lock gates, and other ironwork, as well as the clearing away of the dams up and downstream, and the filling up of the temporary diversion. The work will have cost altogether, when payments are complete, £E.26,421 of which £E.9,033 was the amount expended during 1902, and £E.265 remains to be expended in 1903.

IRRIGATION IMPROVEMENTS.

Earthwork and minor Masonry Works.

The following is the list of the works under this head:—

	£E.	
<i>1st Circle.</i>		
Head Sluice Bahr Fakus	205	
Head Sluice Awlad Musa	134	
Pipes and bridges... ..	157	
Sisa Canal conversion, Head Sluice, Regulator and tail Escape	1390	
Earthwork	4157	
	<hr/>	5,547
Marsafawia conversion	1,465	
Um Galagil conversion	1,431	
	<hr/>	8,942
<i>2nd Circle.</i>		
Khott Canal Head Sluice	366	
Beltag Regulator on Gafaria	994	
Various small head sluices and closing gear	2,030	
3 Mithern syphons.	856	
Regulator and outlets on Mellawinia Canal	770	
Remodelling Bussinn & Kodaba Regulators	1,260	
Land taken for Kodaba Canal in 1901.....	537	
Nigail Canal	9,870	
Kafr Tambidi Canal	1,813	
	<hr/>	25,496
<i>3rd Circle.</i>		
Inspection House Damnuhur	1,200	
Buricut Regulator : Materials	1,043	
Various small works	918	
Widening Sahel Markaz Canal... ..	13,826	
Mahmudian Canal Banks	3,997	
	<hr/>	20,984
<i>Delta Barrage Directorate.</i>		
Giza Inspection House and Offices	1,650	
Geziret Sol culvert.	434	
Kafr Ammar Inspection House... ..	542	
Wardan lock : Materials	910	
Various small works	1,818	
Kafr Tarkhan Canal remodelling	2,021	
Nigail Canal	1,180	
	<hr/>	8,555
Total	<hr/>	£E.63,977

In the group of 1st Circle works are included three conversions of canals from "Nili" to "Sefi." On two of these, expenditure was incurred in 1901 in expropriating land to the following amounts:—

	£E.
Marsafawia Canal	1405
Um Galâgil Canal	1889

Of the advisability of converting the Um Galâgil, which is in the North of the Delta, there is little question; but the same cannot be said of the conversion of the Sisa and Marsafawia. These two canals have been converted as a concession to persistent demands for the conversion, and from sympathy with those who clamoured for it, in the desire to be independent of the large pump owners in whose power they felt themselves to be. But as these two canals are in close proximity to the Delta Barrage and therefore, as Sefi canals must have their beds at a low level relatively to the country levels and flood levels, it is certain that they will be costly canals to maintain by reason of the heavy deposits that may be expected to collect in them during flood. We have plenty of similar instances in existing canals, and know what to expect. They are expensive works to execute and to maintain, and I should hesitate to recommend the conversion of other canals similarly situated as regards the Delta Barrage.

In the 2nd Circle the 3 Mitbera syphons and the Misherif Canal in connection with two of them, have been completed. The pipes for the syphons were purchased in 1901 and an expenditure of £E.800 incurred, which, added to the £E.856 expended in 1902, gives a total cost for these three works of £E.1656. Their construction will enable a very clumsy arrangement of water distribution to be abolished.

The remodelling of the Bassium and Kodaba Regulators will be carried out in 1903. The amount expended in 1902, £E.1260, was for the collection of material.

The Nigail Canal, formerly called the West Nili Canal, takes off from above the Barrage between the Rayyah Menufia and the Rosetta Branch. The Nigail Canal project is an important one, its object being the improvement of the irrigation of a large area of high level land north of the Barrage, and at the same time the avoidance of the necessity of holding up water to high levels in the Rayyah Menufia itself and its upper branches during flood, a proceeding which encourages heavy silt deposit in these deeply dug canals and a correspondingly high expenditure for its removal to enable them to carry their summer discharges. In 1901 a sum of £E.1200 was expended in purchasing pipes for the syphon required under the Naggar Canal; and a further

sum of £E.983 was expended by the Barrage Directorate in constructing a head sluice to the canal. In 1902 the Barrage Directorate remodelled the upper part of the canal as far as the West Weir at a cost of £E.1180, and the 2nd Circle expended £E.9870 more in carrying on the work down to and across the Nanaiia Canal. The principal masonry works on the canal are a syphon of 3 two-metre diameter pipes under the Naggar Canal, and an iron-trough aqueduct supported on the wings of the previously existing head of the Nanaiia Canal. The trough is so placed that a second can be laid alongside it when it is desired to further develop the project. The trough is 13 metres in length, 3 metres wide and 3 metres deep, and weighs 32 tons.

The expenditure on this Nigail Canal to the end of 1902 has therefore been :—

	£ E.	Year.
Head Sluice (by Delta Barrage)	983	1901
Pipes purchased (by 2nd Circle)	1200	
Canal: Head to Weir (by Delta Barrage)	1180	1902
.. Weir to Nanaiia Head (by 2nd Circle) ...	9870	
Total	<u>£E.13,233</u>	

In the 3rd Circle the most important work in the foregoing list is the widening of the Sahel Markas Canal on which the year's expenditure was £E.13,826. The project is now completed. The object of the work was described on page 180 of the Report for 1899. The expenditure has been as follows :—

Year.	£ E.
1898	287
1899	1,055
1900	7,354
1901	10,227
1902	13,826
Total	<u>£E.32,649</u>

The remodelling of the Mahmudia Canal banks and demarcation of Government property was proceeded with, and a sum of £E.3,997 expended. The work was begun in 1901 with an expenditure of £E.1,199. A length of 10 kilometres of single bank is now completed on the north-side of the Canal from Kafr Dawar towards Alexandria. The work includes the formation of a road 8 metres wide, the planting of trees, the fixing and marking of boundaries and the construction of new culverts. It appears from the foregoing figures that the work is costing £E.500 a kilometre.

In the Barrage Directorate preparations were made for the remodeling of the Kafr Tarkhan Canal in East Giza by expropriating the land required; and for building a lock in association with the Wardan Regulator by purchasing materials.

NEW AND REMODELLED DRAINAGE WORKS.

The expenditure during 1902 on Drainage Works, exclusive of staff charges, was as below:—

	£E.
1st Circle... ..	21,964
2nd Circle.	19,611
3rd Circle..	23,047
Total... ..	<u>£E.64,622</u>

The Drainage Works executed are given in the following list:—

<i>1st Circle.</i>	£E.	
Bilbeis Drain extension, including the Abu Zaabal syphon	8,323	
Neghir Drain... ..	947	
Um Salama Drains	1,086	
Boundary stones and land	1,629	
Dredging Main Drain Bahr el Bagar	6,800	
Dredging Main Drain Bahr Hadus	3,165	
Extension of Suez T Drain... ..	14	
	<u>21,964</u>	
<i>2nd Circle.</i>		
Tail escape Bahr Biela... ..	150	
Aidia Drain	229	
Banawan Drain	5,565	
Abu Nom Drain	1,901	
Abu Khashaba Drain	3,027	
Samutay Drain (N° 6)... ..	1,080	
Waziria Drain (N° 7)... ..	3,461	
Ariaman Drain (N° 8)... ..	1,583	
Land and Survey... ..	2,615	
	<u>19,611</u>	
<i>3rd Circle.</i>		
Nubaria Drain.	4,331	
Sorombay Drain	200	
Kafr Beni Helal Drain.	2,765	
Umum Drain... ..	6,822	
Gabhares Drain	3,374	
Khuiry Drain..	3,212	
Survey and sundries	2,343	
	<u>23,047</u>	
Total... ..	<u>£E.64,622</u>	

The usual detailed information about these drainage works is given in the Appendices.

The Abu Zabal Syphon on the Bilbeis Drain, intended to carry the drainage of Marg and its neighbourhood under the Ismailia Canal, is a work of sufficient interest to require special notice. The syphon consists of a pipe of 1.50 metres diameter and 84 length, of half-inch steel plate stiffened with angle-irons, and having 8-inch cover-plates over the joints. The pipe was put together on the bank and floated into position, where it was made to sink into a trench which had been dredged out ready for it. The tube was closed at the two ends, and means of letting in the water provided. When the pipe had sunk to its half diameter, it tilted, one end sinking to the bed and the other rising out of the water. The pipe appears to have stood the strain of the shock without damage resulting. The same thing, I believe, happened with the Ibrahimieh syphon in Middle Egypt, but not without damage in its case. Some method of dividing the pipe into separate compartments should have been devised to prevent one end sinking in advance of the other. Or a raft at each end of the pipe to support it with ropes, which could be paid out evenly, would have been sufficient to secure the sinking of the pipe in a horizontal position till the bed, on which it was to lie, had been reached.

The pipe having been got into place, it remained to build the masonry ends. This proved an exceedingly difficult task, as the soil below and around the pit was quicksand. Eventually the ends were formed as wells, and sunk ; but, at the time of writing this Report, the spaces between the tube-ends and the masonry of the wells had not been successfully closed.

In the 3rd Circle it was found necessary to dig a deep channel of reduced width along the bed of the Khairy Drain, as the original scheme of drains has not been carried out to the full extent originally contemplated, and, the drain being too large for present requirements, weeds grow over its bed and arrest the flow. The original project moreover, allowed 10 cubic metres a feddan for the whole area to be eventually drained, which it is now thought is too liberal an allowance for a main drain. Probably 8 cubic metres a feddan is a suitable allowance. This was the figure that was originally adopted, when drainage works were first projected, but afterwards it was considered too small. No doubt it is too small for branch drains of no great size, but it is probably fully sufficient for a large main drain of an extensive system.

Mr. Williams gives statistics to show that the areas of cotton and winter crops in Behera Province have been steadily increasing since

1894, and this is doubtless due to the gradual reclamation of previously uncultivated areas which the drainage works has made possible. The cotton area in 1894 was 149,826 feddans: in 1902 it was 240,080 feddans, the latter figure being reached by steady and uninterrupted annual increases. The winter crop area in 1894 was 268,050 feddans: in 1902 374,894 feddans. It, therefore, appears that the cropped areas in Behera Province have increased nearly 40 per cent during the last eight years.

In the 1st and 2nd Circles, likewise, reclamation has been steadily progressing, but not at the same rate, as such extensive areas of reclaimable swamps, as existed in the 3rd Circle eight years ago, were not to be found in the other Circles.

The earthwork cubes executed on the Drainage Works and the cost are given by the following figures:—

CIRCLE.	DREDGING		HANDWORK.		TOTAL.	
	Quantity.	Cost.	Quantity.	Cost.	Quantity.	Cost.
	c.m.	£F.	c.m.	£F.	c.m.	£F.
1st Circle ...	293,093	9,956	74,312	1,622	367,405	11,587
2nd Circle ...	52,975	1,801	701,202	11,417	754,177	13,218
3rd Circle ...	109,927	3,737	582,094	11,205	692,021	14,942
Totals ...	455,995	15,503	1,357,608	24,244	1,813,603	39,747

The lengths of drains dug and remodelled, and the year's expenditure, as well as the total expenditure up to date, are given in the statement below:—

CIRCLE.	NEW DRAINS.			REMODELLED.		
	1897 to 1901	1902	Totals.	1897 to 1901	1902	Totals.
1st Circle...	497	1	498	358	10	368
2nd Circle...	359	29	388	465	27	492
3rd Circle...	205 $\frac{1}{2}$	—	205 $\frac{1}{2}$	288	69	357
Totals ...	1,061 $\frac{1}{2}$	30	1,091 $\frac{1}{2}$	* 1,111	106	1,217

* This figure was incorrectly given in the Report of 1901.

SOURCES FROM WHICH FUNDS WERE OBTAINED.

YEAR.	From Caisse de la Dette.	From Public Works Budget.	From other Sources.	Totals.
	£E.	£E.	£E.	£E.
1897	248,019	34,002	3,513	285,534
1898	252,700	26,254	—	278,954
1899	144,773	49,179	—	193,952
1900	156,173	11,270	—	167,443
1901	139,012	1,268	—	140,280
1902	68,547	—	—	68,547
Totals £E.	1,009,224	121,973	3,513	1,134,710

CHAPTER VI.

WORKS OF MAINTENANCE AND REPAIRS.

RIVER AND CANAL PROTECTIVE WORKS.

The works under this head were made up of the following:—

<i>1st Circle.</i>		£E.	
River spurs and revetments	4,132		
Rayyah Tawfikî spurs	1,595		
			5,727
<i>2nd Circle.</i>			
River spurs and revetments	8,643		
Rayyah Menufî spurs	2,507		
Grass planting canal slopes	937		
Shieshâ dam	4,197		
			16,284
<i>3rd Circle.</i>			
River spurs and revetments	8,517		
Grass planting	150		
Abukîr sea wall	1,987		
			10,654
<i>Delta Barrage Directorate.</i>			
River Training above Barrage	2,672		
River spurs and revetments, Giza	3,422		
			6,094
Total		£E.38,759	

The object and nature of these protective works has been described in previous Reports. The Shieshâ dam is the only item that calls for special remark. This dam was made on the Rosetta Branch a few kilometres below the Delta Barrage to close the deep summer channel of the river where the right bank was being dangerously eroded along a sharp bend, close behind the edge of which are the Nile banks and canals of too great importance to leave in danger. To protect this bend by spurs or ordinary revetment would have been costly and perhaps ineffectual; so, after much hesitation, it was decided as the most economical method in the long run, to dam this deep branch of the river and to force the river to flow on a straight course along the broader and shallower branch under the west bank. The dam stood through the flood season successfully; and, as it has stood one flood season, it should, with proper attention, be permanently secure.

MAINTENANCE.

Masonry Works and Dwelling-houses.

The total expenditure under this head was £E.18,205, about £E.2,000 more than the two preceding years. This expenditure includes stone pitching below masonry works to fill holes scoured out beyond the floors, though this has sometimes been classified as flood protective works; in my opinion, wrongly.

The only work worth special mention is the Kafr Bulin Escape work. The canal water level in the Rayyah Behera in summer is about $6\frac{1}{2}$ metres above the river water level, and the length of the escape channel from canal to river is about a kilometre. It is often necessary to escape water from this escape when there is a heavy fall between the canal and river, and there is danger of the bed of the escape scouring out and cutting back to the masonry escape. With such a difference in summer between the canal and river levels, the escape would then be endangered. To prevent such cutting back, a series of four small weirs, in cascade but at considerable intervals, have been constructed in the length of the escape channel. The sum expended on these in 1902 was £E.1,870.

EARTHWORK BY HAND.

The quantities and cost of earthwork by hand in maintaining canals, drains and banks are given separately for Circles below:—

CIRCLE.	QUANTITY	COST	Rate per cubic metre.
	C.M.	£E.	MIL.
1st Circle.	2,748,451	43,996	16.0
2nd Circle.	2,940,524	59,989	20.4
3rd Circle.	833,767	19,831	23.7
Delta Barrage	731,952	9,932	13.5
Total	7,254,694	133,748	18.4

To the cost of earthwork in the above table, there is to be added, to obtain the figures given in the statement of actual expenditure, the following sums:—

	£E.
2nd Circle.—Boundary stone kilo posts	204
3rd Circle.—Boundary stones and survey	2197

making the total cost of the earthwork maintenance charges in 2nd Circle £E.60,193, and in the 3rd Circle £E.22,028.

In the following statement are collected the figures representing all the earthwork executed by hand during the year, both maintenance and new work, excepting only that done on Agricultural Roads and in the Wadi Tumilat, and also the temporary work done in throwing up hoshah banks and making channels necessitated by the low levels of the flood.

CLASS OF WORK.	1st Circle.	2nd Circle.	3rd Circle.	Delta Barrage Directorate.	Totals.
	C.M.	C.M.	C.M.	C.M.	C.M.
Irrigation Improve- ments	307,724	242,856	643,584	121,846	1,316,010
New Drainage Works.	74,312	701,202	632,683	—	1,408,197
Maintenance	2,748,451	2,940,524	833,767	731,952	7,254,694
Totals	3,130,487	3,884,582	2,110,034	853,798	9,978,901
Cost ... £E.	49,146	74,771	45,554	12,265	181,736
Rate millimes per cubic metre ...	15.7	19.2	21.6	14.4	18.2

A further sum of £E.1192 was expended in the 1st Circle in keeping channels clear of weeds.

The low rate of the Barrage Directorate is due to nearly all the work of maintenance being dry work, such as repairs to basin banks and the clearance of dry canals in Giza. The difference between the rate of earthwork in the 1st Circle on the one hand, and of the 2nd and 3rd Circles on the other, is not easily explained. The small proportion of drainage works in the 1st Circle would afford a natural explanation, were it not for the fact that the difference of rates of the first Table are even greater than those of the second Table. The 3rd Circle rates are decidedly high as compared with previous rates. The rates in the 1st and 2nd Circles, however, are practically the same as in the preceding year.

A great deal of the work included as maintenance is made up of the remodelling of the banks of branch canals, or remaking them were they had entirely disappeared, having been removed by the Fellahs to obtain earth for spreading on their fields. In last year's Report it was stated that Inspectors of Irrigation had their attention called to the fact that much useless work was annually included with useful canal clearances; and that they had been instructed to stop the useless work and to spend the sums economised on clearances of drains and remodelling of canal banks. The instructions have been attended to more or less thoroughly in the different Circles. The 2nd Circle has taken the lead in this matter, and great activity and well expended energy is evident in the improved condition of the canals and masonry works and their surroundings, a fact which makes inspections in that Circle a pleasure.

DREDGING BY MACHINERY.

The usual five years' statement of dredging quantities and cost is here given:—

CANALS AND DRAINS.	1897-1898	1898-1899	1899-1900	1900-1901	1901-1902
	C. M.	C. M.	C. M.	C. M.	C. M.
1ST CIRCLE.					
<i>Maintenance.</i>					
Ismailia and Suez branch. ..	224,316	*322,471	225,096	190,790	181,007
Sharkwin	114,046	125,557	77,402	82,647	161,662
Bassand	120,485	152,854	195,970	229,835	246,152
Kumbatin	64,848	51,412	62,504	84,622	76,887
Bahr saghir	59,627	2,823	70,197	32,115	34,816
Mansura lock	15,900	29,648	15,000	21,437	14,625
Bahr el Bazar	—	—	—	—	5,4164
Total Maintenance ..	650,528	677,745	646,228	641,455	634,579
<i>Remodelling.</i>					
Sanaytah lock	—	5,853	—	—	—
Siro drain	50,413	—	—	—	260,000
Bahr el Bazar drain	227,382	245,853	433,640	212,140	231,003
Bahr Tawil drain	—	116,706	72,944	60,525	93,003
Total Remodelling ..	277,800	367,912	506,584	272,665	293,993
Grand Totals	928,328	1,045,657	1,152,812	914,120	947,603
Expenditure .. £ E..	33,400	37,352	40,005	32,500	32,254
2ND CIRCLE.					
<i>Maintenance.</i>					
Menoufia	265,089	399,937	255,535	112,567	131,156
Kasid	112,070	—	138,204	—	—
Bahr Tiran	—	74,810	5,959	—	—
Qudubah lock	6,979	19,530	5,512	13,963	—
Bogaria	—	—	4,424	2,580	4,014
Kafir Rabaa lock	—	—	—	—	5,966
Total Maintenance ..	384,138	484,277	409,634	128,510	141,136
<i>Remodelling.</i>					
Mahdi drain (No. 1)	218,298	84,000	—	142,000	27,681
Demilash drain (No. 2) ..	—	114,000	87,183	—	25,294
Samatay drain (No. 6)	—	—	—	—	—
Total Remodelling ..	218,298	198,000	87,183	142,000	52,975
Grand Totals	603,422	682,277	496,817	270,510	194,111
Expenditure .. £ E..	21,305	20,379	17,110	9,367	6,600
3RD CIRCLE.					
<i>Maintenance.</i>					
Ravash Behera & Kutatin canl.	239,916	185,982	136,516	149,915	82,226
Makaudia canal	120,996	123,431	117,530	139,921	142,927
Mex pump inlet channels ..	11,000	—	—	—	—
Nubaria canal	—	37,980	17,843	—	—
Total Maintenance ..	362,918	347,393	271,889	309,836	224,223
<i>Remodelling.</i>					
Kiniri drain	—	—	—	—	50,589
Sahel Marhah canal	7,652	54,336	—	—	—
Diflahu drain	—	5,863	—	—	—
Shereehra drain	—	—	—	—	—
Edku drain	142,289	250,907	10,634	—	—
Umum drain	48,500	—	99,200	150,849	59,338
Mahmudia Special	—	—	82,652	—	—
Total Remodelling ..	168,450	317,228	108,697	150,849	109,927
Grand Totals	531,368	664,621	470,586	460,685	334,150
Expenditure .. £ E..	10,561	21,876	17,033	15,063	11,387

*The Ismailia cube for 1898-1899 includes 80,000 cubic metres executed the year before in the Suez branch but not paid for.

The totals for 1902, abstracted from this statement, are:—

DREDGING ON ACCOUNT OF	1st Circle.	2nd Circle.	3rd Circle.	Totals.
	C.M.	C.M.	C.M.	C.M.
Maintenance Canals and Drains.	654,570	141,156	224,253	1,019,979
New Drainage Works	293,093	52,975	109,927	455,995
Totals... ..	947,663	194,131	334,180	1,475,974
Cost... .. £F.	32,220	6,600	11,387	50,207

The maintenance dredging cubes of the 2nd Circle show that the decrease in the cubes of the preceding year is repeated, and the prospects of 1903 seem to show that the decrease is permanent. There has been a considerable decrease also in the cubes dredged on the Rayyah Behera in the 3rd Circle. In the 1st Circle, in spite of the economy resulting from the raising of the bed of the Ismailia Canal, there is no decrease in the maintenance dredging. In 1903 the levels to be dredged to in the Ismailia Canal are being still further raised, and those also of the Basusia and Sharkawia have been raised slightly. The result of this should be a decrease. In 1904 the new Shubra Head will be in working order, and the large volume of deposit, which hitherto has been found after the flood above the old Head, should cease to be formed, and this large item of expenditure under the head of dredging should disappear.

TOTAL EARTHWORK FIGURES: HANDWORK AND DREDGING.

Collecting all the foregoing figures of Hand Work and Dredging together, the total earthwork done in 1902 is given by the following figures : —

HAND WORK IN LOWER EGYPT AND GIZA.	Quantities	Cost.
	C. M.	£F.
Maintenance of Banks, Canals and Drains ...	7,254,694	—
Irrigation Improvements	1,316,010	—
New Drainage Works	1,408,197	—
Totals... ..	9,978,901	181,736
DREDGING		
Maintenance of Canals and Drains	1,019,979	—
New Drainage Works	455,995	—
Totals... ..	1,475,974	50,207
Total Hand Work and Dredging... ..	11,454,875	231,943

The total cube executed in 1902 was over 3 million cubic metres less than the quantity executed in 1901. This is due to the special allotments having been correspondingly less.

MISCELLANEOUS.

The Caisse de la Dette granted during 1902 £E.11,000 to meet special expenditure connected with the low level of the river in summer, and also £E.3,000, later on, for special expenditure necessitated on account of the lowness of the flood. Of the former sum, £E.7,500 was for the expenses of Atfeh pumping station, and £E.1,000 for additions to the Mehallet El Emir Sadd; the account of the expenditure under these heads will be found included in the account of temporary dams in Chapter I, and of pumping stations Chapter III.

Of the remaining £E.2,500 of the summer grant and £E.3,000 of the flood grant there was expended £E.4,032 on special rotation staff and Hosha banks. The remainder of the grant was transferred to Upper Egypt, not being required in Lower Egypt.

On account of the cholera epidemic, it was decided to close and fill up the Bulaqia Canal, which was as objectionable a channel on sanitary grounds as the old Khalig of Cairo. A grant of £E.2,000 was made for this filling and for the digging of a new canal to take its place. So much of the work as it was possible to do was executed before the flood and £E.228 expended on it. It was intended to carry out the project to completion in 1903, but a notice has been received from the Finance Ministry that the cholera funds are exhausted and that the unexpended balance of the grant for the suppression of the Bulaqia Canal is no longer available for further expenditure.

During the summer of 1901 the want of drinking water was much felt at Ras-el-Barr at the mouth of the Damietta Branch by those who make the place a summer sea-side resort. Consequently, for their sake and for the sake of the village of Ezbet-el-Borg, a reservoir to be constructed at that village was projected. At first the execution of the work was entrusted to the Tanzim Department, but was later on transferred to the Irrigation. As it was desired that the reservoir should be in working order by the summer of 1902, there was no time

to be lost; and a contract for the supply of materials at site was made before the design had been got out or the money grant made. There was some delay in obtaining funds, but eventually a sum of £E.7,697, was granted, against which £E.5,236 was expended in 1902.

The work was sufficiently advanced to receive water by the time it was required for use, but it was not found possible to construct the roof until, on the arrival of the flood, the reservoir could be emptied.

The inside dimensions of the reservoir are $85.50 \times 25.60 \times 3.30$ metres: it is capable of holding 6,750 cubic metres of water. The use of iron in the construction has been avoided, as it would rapidly corrode: the roof is made of brick arches carried on columns of brick masonry. The rapid decay of the iron roofing of the Damietta cistern demonstrated the unsuitability of iron for the purpose. (See Plan VII.)

In consequence of the completion of the Aswan Reservoir works and the prospect of more extended reclamations of cultivable land becoming possible in Lower Egypt, it was thought advisable to study different projects of proposed reclamation operations. Among them was that of the reclamation of lands along the Nubaria Canal where great possibilities of extension exist, provided only that water be available. In order to prepare the project it was necessary to possess accurate knowledge of the land levels; and consequently a levelling brigade was engaged to obtain the necessary information. A sum of £E.881 was expended during 1902 on these operations: they will be carried on and completed in 1903.

CHAPTER VII.

COMMUNICATIONS.

AGRICULTURAL ROADS.

Construction of New Roads.

The annual progress statement is given below :—

CIRCLE AND PROVINCE.	Existing at end of 1901.	Added during 1902.	Total at end of 1902.	Expenditure 1902.
	Kilom.	Kilom.	Kilom.	£ E
<i>1st Circle.</i>				
Galiubia	107	—	107	{ 325 (for land)
Sharkia	202½	—	202½	
Dakahlia	203½	—	203½	
<i>2nd Circle.</i>				
Menoufia	279	—	279	{ 11,491
Gharbia	709	58	767	
<i>3rd Circle.</i>				
Behera	281½	—	281½	56
Total	1,782½	58	1,840½	11,872

The greater part of the expenditure was for land expropriated the year before. Except in Gharbia Province, roads are making no progress for the reason given in previous Reports.

MAINTENANCE OF ROADS.

A sum £E.2,853 was expended from the Irrigation allotments on repairs to the existing 1782 kilometres of roads. About £E.5,000 is the amount required to keep these roads in proper order, but this should not be drawn from funds required for the maintenance of Irrigation works.

A satisfactory system of maintaining the roads in good order has not yet been found. In the 1st Circle the work was given out as a separate contract with unsatisfactory results. In the 2nd Circle the work was done by gangs of labourers paid by the month, but the sum expended per kilometre was insufficient. In the 3rd Circle the work was given out to the contractor for the general maintenance earthwork of the district "and the work has been satisfactorily done at a cost of £E.500" according to the Inspector of Irrigation. Mr. Langley notifies his intention of adopting this last method in the 1st Circle for 1903.

BRIDGES TO REPLACE FERRIES.

Two bridges to replace ferries were built in the 1st Circle.

	Cost. £ E.
viz : At Abbassa over the Ismailia Canal	1362
At Nawasa el Ghêt over the Mansuria Canal	1545
Total	<u>£E.2907</u>

Of this total amount £E.300 was expended in 1901 and the balance, £E.2,607, in 1902. The first bridge is a swing bridge which works satisfactorily; the second is a lift bridge of one span of 8 metres, which does not yet work smoothly.

The small sum of £E.156, expended in the 2nd Circle, was in settlement of the accounts of the Santa and Melig Bridges built the year before.

In the 3rd Circle an iron bridge was put in hand to replace an old dilapidated bridge at Khatatbeh which showed signs of dissolution from advanced age. £E.1,000 was spent on the bridge during 1902, and it will require a further sum of £E.1,600 to complete it.

CHAPTER VIII.

THE WADI TUMILAT.

RECLAMATION WORKS.

With the expenditure of £E.8,733 incurred during 1902 on works, the project of reclamation works in the Wadi has been almost carried out to completion. The following statement shows the expenditure up to the end of 1902 against the different heads of the original estimate:—

HEADS OF EXPENDITURE.	Original Estimate.	EXPENDITURE.	
		During 1902.	Total to end of 1902.
	£ E.	£ E.	£ E.
<i>Drainage and Reclamation Works.</i>			
Enlargement of pumping station	6,000	791	4,279
Enlargement of main drain	17,000	2,927	14,676
Branch and field drains and field channels...	15,189	2,000	7,925
<i>Remodelling Irrigation Systems.</i>			
Wooden bridges and pipe heads	—	589	—
Three head sluices	—	347	—
	10,000	936	8,717
<i>Purchase of Plant.</i>			
Pump dredger installation	2,500	996	2,905
Pumping in 1899 (wrongly charged to works of reclamation)	—	—	425
<i>Staff and Farm Buildings.</i>			
Four Ezbehs	8,500	297	2,780
<i>Steam Ploughing, Staff and Sundries.</i>			
Pay of staff and travelling allowances... ..	—	527	—
Ploughing	—	259	—
	3,000	786	2,560
Totals... ..£ E.	62,819	8,733	44,267

The enlargement of the pumping station at Kassassin was completed (so far as it is proposed to enlarge it at present) by the erection of a boiler to act as reserve.

The main drain above the pumps was stated to be complete in last year's Report; the outfall drain between the pumps and Mahsama Lake

is now also complete, and a dredger has been purchased and paid for to keep the main drain in order. But the Timsah Drain still remains to be put in order. Included in the £E.17,000 of the original estimate for enlargement of Main Drain is a sum of L.E.12,000 for the enlargement of Timsah Drain including the lowering of the floor of the railway bridge near Ismailia and constructing a new syphon under the Suez sweetwater canal. It is probable now that these items will be charged against other funds, so that, to make a fair comparison between the original estimate and actual expenditure under the different heads, this amount of L.E. 12,000 should be deducted from the original estimate, as it was all intended for work between Mahsama Lake and Timsah Lake.

The new field and branch drains dug during 1902 serve an area of 2,700 feddans of land hitherto uncultivated, leaving an area of 700 feddans of uncultivated land still to be drained.

Three head sluices were built during 1902, completing the works required under the head of "Remodelling Irrigation Systems."

The steam ploughs were at work for six months, breaking up ground covered by weeds and scrub, which native ploughs were unfit to attempt. The work was difficult and progress slow.

REVENUE ACCOUNT.

The receipts and expenditure under the head of revenue accounts are detailed in the following statement:—

RECEIPTS:—

	£E.
Balance surplus remaining at end of 1901	115
Rent of 15,200 feddans	21,921
" " Palm trees	334
" " Grazing and wild "Samar"	210
" " Incubator	20
" " 4 flour mills	144
Sundries	115
Total... ..	<u>£E.22,859</u>

EXPENDITURE:—

Staff	2,012
Taxes	5,920
Payment to Ministry of Public Instruction	8,000
Working expenses pumping station	4,234
Canal and drain maintenance	895
Petty expenses	90
	<u>21,151</u>

Surplus... .. £E.1,708

Deducting the balance surplus of 1901, the surplus for 1902 is £E.1,593, which is the figure to be used in comparing actual results obtained with the forecast.

The Table below gives figures for comparison:—

YEAR OF NEW MANAGEMENT.		Expenditure.	Receipts.	Surplus.	Deficit.
		£E.	£E.	£E.	£E.
Original forecast	1st ...	19,350	15,710	—	3,640
	2nd ...	19,350	17,200	—	2,150
	3rd ...	19,350	19,700	350	—
	4th ...	19,350	22,500	3,150	—
	5th ...	19,350	23,750	4,400	—
Actual results obtained ...	1899...	15,827	16,025	198	—
	1900...	19,643	19,957	314	—
	1901...	20,418	21,138	720	—
	1902...	21,151	22,744	1,593	—
Estimated... .. 1903...		21,000	28,000	7,000	—

The year 1902 was the last of the first three-year period for which the lands were leased. In 1903 the leases have been renewed at higher figures and the rental will show a considerable increase in consequence. Mr. Langley estimates the receipts for 1903 at £E.28,000, which is a considerable increase on the forecast. The area rented in 1903 is 16,700 feddans. The comparison with the original forecast of areas rented is given below:—

YEAR	Actually leased.	Forecast.
	Feddans.	Feddans.
1898... ..	6,917	8,080
1899... ..	7,578	8,000
1900... ..	9,382	9,000
1901... ..	12,337	10,000
1902... ..	15,200	11,000
1903... ..	16,700	12,000

The comparison with the forecast is not a just one except at the end of each triennial period, as the first year of the lease shows better comparative results than the third year, because the rents remain stationary

for the 3 years, the increase of receipts being due to the extension of the area leased only, and not to any improvement in the rents for which the land is leased.

It will be noted in the foregoing figures that the yearly expenditure of maintenance is higher than the forecast. This is almost wholly due to the pumping having cost more than it was expected to. The following figures show the forecast figures and actual figures for 1902.

	Forecast.	Actual for 1902.
Staff	2,000	2,012
Pumping	2,500	4,234
Maintenance of channels	1,000	835
Taxes	5,850	5,920
Payment to Public Instruction... ..	8,000	8,000
Petty expenses	—	90
	19,350	21,151

The higher expenditure on pumping is no doubt due to the reclamation of the land going on at a more rapid rate than was estimated, so that it is not an unhealthy sign.

CONCLUSION.

STAFF.

There were no changes in Lower Egypt during 1902 among the Inspectors in charge of Circles. The Officers in charge were:—

1st Circle... ..	Mr. J. Langley.	Inspector of Irrigation.
2nd "	Mr. C. E. Dupuis,	" "
3rd "	Mr. W. R. Williams	" "
Delta Barrage Directorate	Mr. H. G. Einlaion	" "

Mr. Dupuis went on 3 ½ months' leave in the spring, and P. M. Tottenham acted for him; and continued to act for the rest of the year, as Mr. Dupuis, on his return from leave, was told off to act as Inspector General of Irrigation, Lower Egypt, and, his being relieved of those duties, was appointed to go on a mission to Lake Tana, on

which he started early in December. Mr. Tottenham has carried out his acting duties so efficiently, and has shown so much intelligent interest in them, that I consider he has fully demonstrated his eligibility for the post of an Inspector of Irrigation.

Mr. Adamson acted as Inspector of the 3rd Circle during the 3 ½ months that Mr. Williams was on leave, and acquitted himself very creditably.

Mr. Hurley was Resident Engineer of the Zifta Barrage; his services have been referred to in the body of this Report.

Mr. Walsh and Mr. Sullivan were appointed Surveyors of Contracts during the year.

There were some changes among the Chief Engineers and Bashkatibs, Abdul Wahab bey Zeki, Chief Engineer of South Behera, was retired, and Ahmed Eff. Husni was transferred from the Fayum Province to take his place.

Mohamed Bey Fahmi, Chief Engineer of Gharbia, 1st Section, was transferred to Upper Egypt, and Ahmed Bey Hilmi transferred from Sharkia to take his place; Mohamed Eff. Chafik being given the charge of Charkia Province.

Ibrahim Eff. Nadim, Bashkatib of the 1st Circle, and Mohamed Eff. Effat, Bashkatib of the 2nd Circle, were retired.

Aly Bey Naggar, Chief Engineer, was also retired: for some time he has not held a Chief Engineer's post.

R. H. BROWN

APPENDICES.

APPENDIX A.

ABSTRACT OF ACCOUNTS, 1902—IRRIGATION DEPARTMENT, LOWER EGYPT.

REGULAR HEAD.	1st Circle.	2nd Circle.	3rd Circle.	Barrage.	Zifta Barrage.	TOTALS.
	£E. Mill.	£E. Mill.	£E. Mill.	£E. Mill.	£E. Mill.	£E. Mill.
REGULAR BUDGET.						
<i>Establishment.</i>						
Classified staff	9,190,905	8,877,143	6,859,421	2,526,000	—	27,453,469
Unclassified staff	4,357,890	4,419,272	2,850,782	3,868,858	—	15,496,802
Travelling charges.	2,600,655	3,178,528	2,332,427	658,255	—	8,769,865
Telegrams	253,206	316,135	159,980	24,980	—	754,301
Dahabiyas	374,100	—	225,000	156,222	—	755,322
Office charges and furniture ...	100,000	350,755	59,981	30,000	—	540,736
<i>Works.</i>						
Irrigation improvements	12,000,000	3,029,000	11,698,314	21,478,330	—	48,205,644
Flood protection works	6,400,000	8,364,002	3,875,000	3,279,800	—	21,918,802
Maintenance and repairs	5,127,039	3,550,047	2,410,350	10,746,870	—	21,834,306
Repairs of roads	1,400,000	800,000	500,000	—	—	2,700,000
Pumping stations	—	—	10,450,000	—	—	10,450,000
Corvée abolition works	24,500,000	28,299,746	15,299,979	4,499,104	—	72,598,829
Survey Nubaria	—	—	881,000	—	—	881,000
Totals, Regular Budget. ...	66,303,795	61,184,718	57,602,234	47,268,419	—	232,359,166
<i>Corvée abolition</i>	<i>46,000,000</i>	<i>42,000,000</i>	<i>26,349,370</i>	<i>7,650,000</i>	<i>—</i>	<i>121,999,370</i>
<i>Agricultural Roads</i>	<i>325,001</i>	<i>11,437,178</i>	<i>56,349</i>	<i>—</i>	<i>—</i>	<i>11,818,528</i>
<i>Bridges to replace ferries ...</i>	<i>2,607,310</i>	<i>155,435</i>	<i>1,000,000</i>	<i>—</i>	<i>—</i>	<i>3,762,745</i>
SPECIAL GRANTS BY CAISSE FROM GENERAL RESERVE.						
Drainage works	23,119,216	23,601,515	21,826,261	—	—	68,546,992
Irrigation improvements	31,447,267	32,591,093	19,434,459	15,194,007	—	98,666,826
Special Low Nile credit	645,909	569,772	7,401,932	38,122	—	8,655,735
Special Low Flood credit	133,443	—	973,740	750,000	—	1,857,183
Mehallet El Amir dam	—	—	9,000,000	—	—	9,000,000
Damietta Sudd	4,563,093	—	—	—	—	4,563,093
New Weirs	—	—	—	2,235,195	—	2,235,195
Zifta Barrage	—	—	—	—	209,081,132	209,081,132
Ezbet el Borg Reservoir	5,236,256	—	—	—	—	5,236,256
Bulaqia Canal	227,784	—	—	—	—	227,784
Totals, other credits. ...	114,305,279	110,354,993	86,042,111	25,867,324	209,081,132	545,650,839
Grand Totals. ...	180,609,074	171,539,711	143,644,345	73,135,743	209,081,132	778,010,005

APPENDIX B.

ABSTRACT OF DRAINAGE WORKS IN 1902.

NAME OF DRAIN.	Length in kilom.		Earthwork.			Land.	Expen- diture on works.	Total Expen- diture.
	New channel.	Renovated channel.	Dredging.	Hand- work.	Cost.			
			£ M.	£ M.	£ E.	£ L.	£ E.	£ E.
BAHR EL BAGAR SYSTEM.								
Main drain... ..	—	7	200,000	—	6,800	—	—	6,800
Bilbeis branch	—	—	5,000	74,312	1,877	3,660	2,786	8,323
NIZAM HADUS SYSTEM.								
Main Bahr Tawil	—	3	93,088	—	3,165	—	—	3,165
Um Salama	—	—	—	—	—	526	560	1,086
SIBU SYSTEM.								
Neghir drain	—	—	—	—	—	—	947	947
MISCELLANEOUS.								
Cost of land occupied previous to 1902	—	—	—	—	—	—	—	1,530
Boundary stones for drains	—	—	—	—	—	—	98	98
Extension of T drain at Suez... ..	—	—	—	—	—	—	—	14
TOTALS	—	10	293,088	74,312	11,842	4,186	4,391	21,963

APPENDIX C.

DETAIL OF EXPENDITURE OF WORKS.

NAME OF DRAIN.	DESCRIPTION OF WORK.	EXPENDITURE.	TOTAL.
		£ F.	£ E.
BAHR EL BAGAR SYSTEM.			
Bilbeis branch	Balance of cost of pipes	720	2,786
	Bilbeis syphon	700	
	27 wooden bridges	506	
	Menawar syphon	450	
	Abu Zaubal syphon	*410	
NIZAM HADUS SYSTEM... ..			
Um Salama	Transport and erection of pipes ...	560	560
SIRU SYSTEM.			
Neghir drain	13 wooden bridges	104	947
	Pipes	843	
Boundary stones for drains			
		98	98
Total			4,391

*Charged to Regular Budget.

APPENDIX D.

ABSTRACT OF DRAINAGE WORKS EXECUTED IN 1902 IN THE 2ND CIRCLE.

NAME OF DRAIN OR IRRIGATION CHANNEL.	Length in kilometres.		Earthwork, including dredging.		Land acquired but not paid for.		Expendi- ture on works.	Total Expendi- ture.
	New channel.	Rehabili- tated channel.	Cube.	Cost.	Acres.	Cost.		
				£E.	Peddans.	£E.	£E.	£E.
BAHR SHIBIN SYSTEM.								
Abu Nom drain	—	11	92,057	1,564,969	1-15-0	13	322,700	1,887,669
Aidin drain	1	—	8,453	143,761	5-3-0	100	85,320	229,021
Muhit drain (No. 1)	—	2-500	27,681	941,154	—	—	—	941,154
SHARKAWIA SYSTEM.								
Banawan drain	15	—	215,476	3,927,614	103-5-16	172	1,621,568	5,549,182
Bieia Canal Tail Escape	—	—	—	—	—	—	150,000	150,000
BAHR MALLAH SYSTEM.								
Samatay drain (No. 6)	—	2	25,294	866	—	—	220,026	1,080,026
WAZIRIA SYSTEM.								
Waziria drain (No. 7)	—	7-780	177,812	2,933,890	39-16-16	318	517,710	3,451,600
Abu Khushaba drain	13	—	116,222	1,917,668	77-0-0	244	1,060,364	3,008,027
ARIAMUN SYSTEM.								
Ariamun drain (No. 8)	—	3-400	61,182	928,731	—	—	650,165	1,578,896
SUNDRIES.								
Land occupied but not paid for previous to 1902	—	—	—	—	—	—	—	1,808,346
Boundary stones	—	—	—	—	—	—	—	49,150
Kilometre marks	—	—	—	—	—	—	—	2,100
Staff and general expenses	—	—	—	—	—	—	—	3,866,344
TOTALS	29	26-680	754,177	13,217,722	226-16-8	847	4,657,863	28,601,515

These amounts were not expended
during 1902.

APPENDIX E.

DETAIL OF "EXPENDITURE OF WORKS" COLUMN OF PRECEDING TABLE.

NAME OF DRAIN OR IRRIGATION CHANNEL.	DESCRIPTION OF WORK.	EXPENDITURE	TOTAL.
		£ E.	£ E.
Abū Nom Drain	1 C. I. pipe for Irrigation... ..	71,960	
	2 Wooden bridges over the Drain ...	250,740	322,700
	1 Wooden bridge over Sahel Canal...		
Aidia Drain	2 C. I. pipes for Irrigation	33,800	
	1 Wooden bridge	51,520	85,320
Banawan Drain... ..	15 C. I. pipes for Drainage	873,260	
	17 C. I. pipes & syphons for Irrigation	748,308	1,621,568
	10 Wooden bridges		
Biela Canal Tail Escape	Masonry Regulator (Part Payment) ...	150,000	150,000
Samutay Drain (N° 6)	2 Wooden bridges	220,026	220,026
Waziria Drain (N° 7)	4 Wooden bridges	346,235	
	7 W. I. pipes	171,475	517,710
Abū Khashaba Drain	4 Wooden bridges	127,434	
	23 W. I. pipes	736,001	
	1 Turning wooden bridge... ..	80,000	
	Masonry and pitching	146,929	1,090,364
Adriamūn Drain (N° 8)	Wooden bridges... ..	313,153	
	W. I. pipes	305,676	
	Masonry & pitching	31,336	650,165
Total... ..		£ E.	4,657,853

APPENDIX F.

ABSTRACT OF EXPENDITURE ON DRAINAGE WORKS IN 1902.

NAME OF DRAIN.	Length in kilometres.		Earthwork including dredging.		Land.			Expenditure on works.	Total
	New.	Re-model-ling.	Cube.	Cost.	Area purchased.		Cost.		
			C.M.	£ R.	F.	K.	£ R.	£ R.	£ R.
MARJOTIS SYSTEM.									
Umum Drain	—	6.00	260,125	6,234	—	—	—	588	6,822
Gabbares Drain... ..	—	16.500	103,851	2,232	—	—	—	1,141	3,373
Nubaria Drain	—	13.800	163,420	3,187	—	—	—	1,144	4,331
EDKU SYSTEM.									
Khairy Drain	—	19.000	54,500	1,642	—	—	—	—	1,642
Kafr Beni Helal	—	6.800	110,125	1,637	—	—	—	1,198	2,835
MISCELLANEOUS.									
Works done by Railway for Dessunes Diversion	—	—	—	—	—	—	—	—	50
Staff and Sundries	—	—	—	—	—	—	—	—	4,400
Land payments for expropriation of past years... ..	—	—	—	—	88	12	1,224	—	1,224
Boundary Stones	—	—	—	—	—	—	—	—	997
Totals	—	62.100	692,021	14,932	88	12	1,224	4,071	25,674

APPENDIX G.

DETAIL OF EXPENDITURE ON DRAINAGE WORKS.

NAME OF DRAIN.	DESCRIPTION OF WORK.	EXPENDITURE	TOTAL.
		£ E.	£ E.
Umum Drain	6 Road Bridges... ..	236	588
	3 Aqueducts	172	
	Stone revetment	180	
Gabbares Drain... ..	9 Road Bridges	425	1,141
	15 Aqueducts	716	
Nubaria Drain	6 Road Bridges	175	1,144
	14 Aqueducts	255	
	21 Pipe Inlets	224	
	3 Syphons... ..	490	
Kufr Beni Halal	8 Road Bridges	405	1,198
	10 Aqueducts	378	
	15 Pipe Inlets	161	
	4 Syphons... ..	254	
Total... ..			4,071

APPENDIX H.

NILE GAUGES FOR THE YEAR 1902.

DATE.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
	Aswan.	Delta.	Aswan.	Delta.	Aswan.	Delta.	Aswan.	Delta.	Aswan.	Delta.	Aswan.	Delta.	Aswan.	Delta.	Aswan.	Delta.	Aswan.	Delta.	Aswan.	Delta.	Aswan.	Delta.	Aswan.	Delta.
1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
11	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
12	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
13	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
14	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
15	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
16	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
17	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
18	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
19	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
20	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
21	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
22	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
23	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
24	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
25	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
26	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
27	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
28	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
29	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
30	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
31	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

P.K. = pikes, Kilns. T.S. = upstream R.L.

REPORT ON THE NILE RESERVOIR WORKS,

1902

BY

A. L. WEBB,

DIRECTOR GENERAL OF RESERVOIRS.



Sur. Dept. P. W. M.

ASWAN DAM, SOUTH SIDE FROM WEST.

REPORT ON THE NILE RESERVOIR WORKS, 1902.

The Nile Reservoir Works comprise the following:—

- 1.—A Dam and Navigation Locks and Channel at Aswan.
- 2.—A Barrage and Lock at Asyut.
- 3.—A Regulator and Lock at the head of the Ibrahimieh Canal at Asyut.

A reference to last year's report will furnish a detailed history of the Project and a description of the works executed during 1898, 1899, 1900, and 1901, so that it is only necessary here to describe the comparatively small amount of work carried out during 1902.

THE ASWAN DAM.

At the commencement of 1902, there remained 69,000 cubic metres only of masonry to complete the whole of the Dam and Navigation Locks. The bulk of this was finished by the end of May, when the Contractors commenced to dismantle the extensive gantry on the upstream side of the Dam, and clear away all debris in front of the sluices. By the end of June everything upstream of the sluices had been removed, and by the end of July the gap in the masonry at the east flank was closed, and the whole of the masonry of the Dam thus completed.

The erection of the sluice gates in the different groups followed quickly on the masonry, so that before the flood the whole of the gates had been erected, and their working tested. This rapid completion of the sluice gates was most fortunate, as it was thus possible to lower each gate on to the cill, and ascertain and remove any debris or obstruction before the flood, an operation which would have been very difficult after the flood when the filling of the Reservoir commenced.

On the Navigation Locks the erection of the gates, which had been commenced in the previous year, was completed, so that on the 2nd August boats were able to pass through the locks.

A large quantity of work was done on both the southern and northern portions of the navigation channel, where considerable alterations had been thought advisable in the section of the channel and

banks. The whole of the work was completed by the end of July; the result has been very satisfactory.

Engine and boiler houses for supplying hydraulic power for working the lock gates, and for supplying the works with water were built, and the machinery for the former erected.

A new channel 20 metres wide was cut through the rocks in the rapids to the south of the Dam in order to improve the navigation at the head of the western channel.

Preliminary works were commenced at the end of the year in connection with the construction of a new lock north of the Dam, between the existing navigation channel and Aswan town.

The quantities of permanent work executed to the end of the year on all works combined were as follows:—

WORK.	Quantity executed.		Total to complete works.
	to end of 1901.	during 1902.	
	C.M.	C.M.	C.M.
Excavation.	690,370	96,440	786,810
Masonry	475,812	69,631	545,443

The value of permanent work executed is shown below:—

To end of 1901.	During 1902.	To end of 1902.
1,821,817	178,640	2,000,457

Longitudinal Section of line of Dam showing yearly progress of masonry is given on plan IX.

The total payment made to the Contractors to the end of the year is as follows:—

	£ E.
Aswan Dam.	1,646,674
Aswan Navigation Channel	353,783
Subsidiary Works	13,095
Import duties	47,900
Ironwork	106,356
	<u>2,167,808</u>
Less retention	33,000
Total on Permanent Work	2,134,808
Land	29,800
Grand Total	<u>£ E. 2,164,608</u>



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ASWAN DAM, NORTH SIDE FROM WEST.



Sur. Dept. P.W.M.

ASWAN DAM, NAVIGATION CHANNEL 1ST. LOCK.

Although the works were completed before the end of the year, the above figures are not final, as a final payment cannot be made according to the specification until two months after the date of the completion of the works.

A final payment has since been made.

Filling the Reservoir.

Owing to the low state of the river after the flood, and recognising the necessity of not interfering with navigation in the first year of the reservoir's existence, it was decided to commence filling the reservoir much earlier than contemplated in the original reports.

On October 20th the filling was commenced by closing down the sluices in the western channel.

A programme was prepared giving the rate of filling each day; at first it was somewhat difficult to regulate so as to give the levels laid down in the programme, but after a few days' experience of the effect of working the sluices the regulation was carried out very satisfactorily.

Briefly the programme was as follows:—

October	20th.	Commence filling.	Level of Reservoir R.L....	94.80
November	1st.	" " "	" " " ...	97.80
"	15th.	" " "	" " " ...	100.75
December	1st.	" " "	" " " ...	102.78
"	15th.	" " "	" " " ...	104.00
January	1st.	" " "	" " " ...	105.12
"	15th.	" " "	" " " ...	105.54
"	31st.	" " "	" " " ...	106.00

The effect on the river levels was practically not felt, and navigation in no way suffered.

It should be remembered that it was only on account of the exceptionally low flood that the filling of the reservoir commenced so early: it is certainly not advisable to repeat this programme except under similar conditions.

Inauguration Ceremony.

On the 10th December 1902, the inauguration ceremony took place in the presence of a distinguished and representative assembly. At the invitation of H. H. The Khedive, the final stone completing the Dam was laid by H. R. H. the Duchess of Connaught. H. H. The Khedive opened the sluices of the Dam, and H. R. H. The Duke of Connaught opened the Locks.

At the same time orders and decorations were conferred on those whose labours had brought these immense works to a successful termination.

Completion Report.

According to Clause 32 of the Specification a Certificate in writing under the hand of the Engineer, dated 10th December 1902, was given to the Minister to the effect that the works constructed by Messrs. John Aird & Co. were in a sound, watertight, workmanlike and useable condition, and that the Contractors had in the opinion of the Engineer reasonably fulfilled and completed their Contract. The Contractors were, therefore, considered to have made a complete delivery of the works to the Government on that date. To the credit of all concerned, the works were completed one year in advance of the contract time.

Establishment.

Mr. C. R. May was Resident Engineer throughout the year; he was assisted by Mr. Macdonald and a staff of Engineers and Inspectors.

Mr. John Blue was the General Manager of the Contractors, assisted by Mr. Bakewell as Chief Engineer, and a large staff of Engineers and Inspectors.

Mr. E. H. Tabor represented Messrs. Ransomes and Rapier; he was assisted by Mr. Perry and a staff of European Mechanics.

The satisfactory completion of the works is the highest testimony to the success of their arduous task.

The Philae Temples.

In last year's Report a detailed description was given of the method of underpinning the temples on the Island of Philae. At the commencement of the year considerable progress had already been made, and the works were rapidly pushed on, so that by the middle of July they were all completed.

The total expenditure from November 1901 to July 1902 was as follows:—

Underground works	...	...	...	...	...	...	...	£R.
Surface and superstructure works	...	...	...	...	...	...	...	11,822
								2,016
Total...	...	...	...	...	...	...	...	<u>£E.13,839</u>

It is satisfactory to note that no subsidence whatever has taken place in any of the structures where underpinning was carried out; this is most creditable to Dr. Ball, who was in charge of the work, and to Mr. Talbot, the English expert.



Sur. Dept. P. W. M.

ASWAN DAM, NAVIGATION LOCKS FROM NORTH.



SUR. DEPT. P. W. M.

ASSETT BARAGES, NORTH SIDE FROM WEST.

Dr. Ball has submitted an excellent report on the whole work, accompanied by several highly finished plans, which will serve as an interesting record of all the structures on the Philae Island.

The general repairs to the superstructure were carried out by the Antiquities Department, to whom a sum of £E.2,454 was given out of the original grant made by the Caisse de la Dette.

THE ASYUT BARRAGE.

At the commencement of the year there only remained a part of the parapet to complete the whole of the superstructure. During January and the first half of February the superstructure was completed and the regulating gates fixed. In the middle of February regulation was commenced to facilitate navigation through the Lock. All the subsidiary works were completed by the end of May, when the Contractors handed the works over to the Egyptian Government.

The Asyut Barrage in connection with the low flood.

The flood of 1902 ranks as one of the lowest on record, especially in its earliest stages. On the 15th August it was 1.30 metres below the lowest ever known and 2.50 metres below the average of the years 1873-1902. Throughout August and the early part of September the river levels were unprecedently bad and considerable anxiety prevailed in Upper Egypt regarding the irrigation of the basin lands; fortunately an improvement took place and on the 17th September the maximum gauge of 14 pies (R.L. 91.72) was reached at Aswan, or one metre below that of the average year.

In Lower Egypt no anxiety was felt about the low flood thanks to the excellent work done by the Delta Barrages and weirs: throughout the flood regulation was continued.

In Middle Egypt the low levels in the Ibrahimiyah Canal during August caused considerable uneasiness amongst the cultivators regarding the possibility of sowing the large area of durah crops in the existing "sefi" tracts, and in the newly converted basins of the Asyut Province. The situation was so serious that it was decided to completely close the new Asyut Barrage on the 15th August; the result was to raise the level in the Ibrahimiyah Canal 1.50 metres, which means converting a low Nile into a good average one. The Barrage remained completely closed till the 19th September, when the flood had reached

its maximum, and there was no further anxiety regarding the irrigation.

It is satisfactory to note that only a few months after its completion, the Barrage stood this test remarkably well and rendered most excellent service throughout Middle Egypt, the Fayoum and West Gizeh Province.

It is very difficult to accurately estimate the money value of the benefits gained during the flood from the construction of this Barrage; but it may be safely stated that the direct and indirect gain was not less than £E.600,000—and probably more; the cost of the Barrage and subsidiary works (exclusive of the cost of the Ibrahimiyah Canal Regulator and Lock viz: £E.150,000) was £E.720,000. It will, therefore, be seen that the works practically repaid their cost in the first year after their completion.

In order to save Upper Egypt, especially the Keneh Province, from having the large area of Sharaki, which must inevitably result from very low floods, at least one and probably two Barrages similar to that of Asyut, are required for flood irrigation only; this has already been pointed out in the Report of 1899.

Apart from saving the "Sharaki" area and consequently the Government Revenue, these barrages would greatly improve the irrigation and value of large areas of basin lands in low and average floods, which during a cicle of bad years must undoubtedly have deteriorated: it is only in years of really good floods that these lands have received proper flood irrigation.

IBRAHIMIYAH CANAL REGULATOR AND LOCK.

The superstructure remaining over from the previous years was all completed by the end of March; the erection of the ironwork, however, delayed the final completion of the work until the end of June.

Establishment.

Mr. G. H. Stephens was Resident Engineer till the completion of the works; he was assisted by Mr. E. Hood and a staff of engineers and inspectors. Mr. McClure was the agent of the Contractors, assisted by Mr. McQueen and a numerous staff.

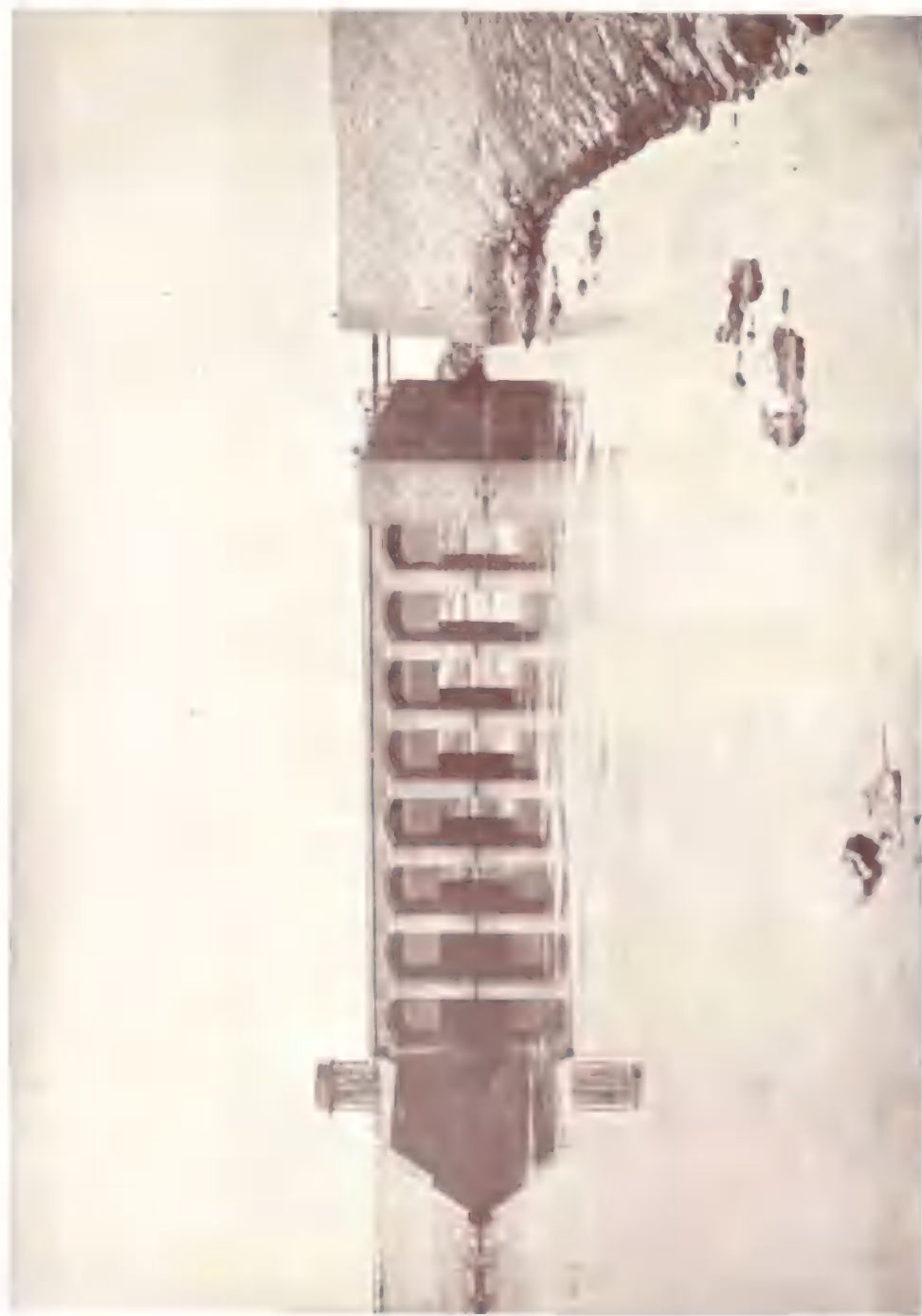
Great credit is due to all the above for the early and successful completion of the works one year before the contract time.





Sur. Dept. P. W. M.

ASYLUM BARRACKS, SOUTH SIDE FROM EAST.



Sur. Dept. P.W.M.

IBRAHIMIA CANAL REGULATOR AND LOCK.

General.

Sir Benjamin Baker, K. C. B., Consulting Engineer to the Egyptian Government, visited the Reservoir Works at Aswan and Asyut, during the year. He was accompanied by Sir John Aird, Baronet, Mr. Basil Ellis and Mr. Malcolm Aird.

Expenditure on Reservoirs Works.

The attached Appendix gives a statement showing the expenditure on the Reservoir Works in the years 1898, 1899, 1900, 1901 and 1902, as well as the total to the end of the year.

A. L. WEBB.

APPENDIX.

STATEMENT SHOWING THE EXPENDITURE ON RESERVOIR WORKS TO END OF 1902.

	EXPENDITURE IN					
	1898	1899	1890	1901	1902.	TOTAL.
	£	£	£	£	£	£
Permanent Work, Aswan Dam ...	20,885	273,075	567,016	840,921	298,560	2,000,457
Retention under Clause 39 of Specification... ..	3,132	29,264	604	—	—	33,000
Payment on account of Permanent Work.	17,753	243,811	566,412	840,921	298,560	1,967,457
Advanced on Preliminary Works, Aswan Dam	20,729	72,746	71,029	—138,292	—26,212	—
Advanced on Plant	31,940	33,545	—8,915	—56,844	—18,826	—
“ Materials	25,376	112,813	45,685	—137,918	—75,958	—
“ to Messrs. Ransomes and Rapier	—	55,972	69,133	106,693	96,748	328,546
Total payment on account of Aswan Dam	24,898	568,887	743,344	614,562	274,312	2,296,003
Advanced on account of Asyut Weir and Lock	16,924	271,917	210,765	232,740	75,960	870,406
Advanced on account of payment for Land... ..	23,400	12,100	4,500	500	—	40,500
Advanced on account of Import Duties	8,100	18,900	13,000	9,000	—1,249	47,751
Subsidiary Works	3,934	8,731	—1,375	1,526	1,969	14,845
Total... .. £	176,356	883,533	1,006,294	858,328	350,992	3,269,505

REPORT ON THE TANZIM DEPARTMENT,

1902

BY

A. H. PERRY.

REPORT ON THE TANZIM DEPARTMENT, 1902.

Cairo, April 26th, 1903.

TO THE UNDER SECRETARY OF STATE,
PUBLIC WORKS DEPARTMENT.

SIR,

I have the honour to submit a Report on the various works executed by my Department in 1902.

In the six years from 1896 to 1902 approximately one and a fifth million pounds have been spent on the construction of public buildings. Details are attached.

The following Officers have done specially good work:—

Special Works.—Messrs. Clifton, Hewat, Pastour, de Cosson, Watson.

Tanzim.—MM. Said Bey Choucri, Schauffelle.

Repairs.—Messrs. Chapman and Ehrlich.

Cairo Voirie.—M. Reboul.

Waterworks and Voirie.—Mr. Curtis.

Electricity.—M. Jacot des Combes.

Gas and Cart Service.—Mr. Fitz-Patriek.

Accounts Office.—Habib Effendi.

I have the honour to be,

Sir,

Your obedient servant,

A. H. PERRY,

Director General of Towns and State Buildings.

CREDITS OPENED BY CAISSE DE LA DETTE

FOR

CONSTRUCTIONS, COMPLETION AND GROSS REPAIRS TO STATE

BUILDINGS FROM 1896 TO 1902.

I.—SCHOOLS.

	£E.	Mill.
Nasrieh School	30,000	000
Girl's School " Sanieh "	19,625	000
School of Agriculture... ..	21,450	000
School of Law	17,725	000
Chibin-el-Kom School	8,000	000
Atelier Modèle, Cairo... ..	14,250	000
	<hr/>	111,050 000

II.—PALACE OF JUSTICE AND TRIBUNALS IN PROVINCES.

Native Courts in Cairo	99,000	000
Palace of Justice, Alexandria	9,500	000
Tribunal, Mansourah	5,150	000
" Chibin-el-Kom	3,500	000
" Ayat-Port-Said	7,000	000
" Luxor	3,500	000
	<hr/>	127,650 000

III.—HOSPITALS.

Hospital, Sohag	4,000	000
Lunatics' Asylum, Cairo	15,500	000
Hospital, Assiut	8,000	000
" Minieh	7,500	000
" Port-Said	7,500	000
" Infectious diseases at Alexandria	5,000	000
" Tintah	3,000	000
" Suez	8,000	000
Staff for works at Hospitals for which the credits have been transferred to Sanitary Department (1901 and 1902)... ..	3,270	000
	<hr/>	61,770 000

Carried over £E.300,470 000

Brought forward... ... £E.300,470 000

IV.—POLICE BARRACKS AND GOVERNORATES.

13 Markaz	24,000	000
Supervision	3,000	000
8 Markaz	10,000	000
Police Barracks at Quay, Alexandria	1,900	000
3 Markaz	7,500	000
Police Post at Darb-el-Ahmar	3,000	000
Markaz Bilbeiss	3,400	000
„ Tantah	3,800	000
Governorate of Port-Said	18,000	000
	<hr/>	74,600 000

V.—PRISONS.

Tantah Prison	33,952	000
Alexandria Prison	25,745	000
Cairo (Manchia) Prison	43,061	441
Beni Souef Prison	25,843	559
Zagazig Prison	8,423	000
Abou Zaabal Prison	475	000
Lunatic prisoners at Tourah	2,000	000
	<hr/>	139,500 000

VI.—POST OFFICES.

Cairo Post Office (extension)	14,000	000
Port-Said Post Office	25,325	000
Alexandria Post Office	665	000
	<hr/>	39,990 000

VII.—CUSTOM-HOUSES.

Tobacco Stores at Alexandria	40,040	000
Sheds, etc., sundry works and repairs to the Custom-House also to terraces, Coast-Guards Alexandria	33,135	000
Sundry works at Custom House, Suez	1,937	500
Sundry works, Custom-House, Port-Said	1,865	000
	<hr/>	76,977 500

VIII.—CREDIT FOR PRESERVATION OF ARAB MONUMENTS	22,500	000
	<hr/>	

Carried forward... ... £E.654,037 500

Brought forward... .. £E.644,037 500

IX.—MUSEUMS.

Museum of Egyptian Antiquities	255,521	000	
Arab Museum and Khedivial Library (an additional credit of £E.5,000 has been given by the Department of Public instruction besides)	53,300	000	
Geological Museum	5,300	000	
			315,121 000

X.—CAIRO VOIRIE.

New Stables, Cairo	6,000	000	
Rain water drains	22,000	000	
Road from Choubra to Rod-el-Farag	5,390	000	
			33,390 000

XI.—TANZIM OFFICES IN THE PROVINCES.

New Office at Tanta	2,100	000	
Tanzim Offices in the Provinces: Esna, Nawa and Kom Hamada	9,500	000	
			11,600 000

XII.—SUNDRY GROSS REPAIRS TO GOVERNMENT BUILDINGS

... ..	13,200	000	
			13,200 000

XIII.—SUNDRY.

Fire Brigade Station, Cairo	18,675	000	
Annex Caisse de la Dette	2,100	000	
Lazaret Port-Said	3,000	000	
Dairy and cow-shed, Ghizeh	2,500	000	
Cages for animals at the Zoological garden... ..	7,400	000	
Office for reproduction of plants	2,800	000	
Khedivial Observatory, Helouan	6,000	000	
Repairs to Ras-el-Tin Palace	4,400	000	
Repairs Legislative Council's Hall... ..	2,000	000	
Esbekieh latrines (transferred to Sanitary Department)	1,330	000	
			50,205 000

Total of Credit... .. £E.1,077,553 500

RECAPITULATION.

	£E.	MILL.
Credits for works done by Tanzim... ..	1,023,353	500
" " " Sanitary Department	31,100	000
Credits for works done by Committee for Preservation of Arab Monuments	22,500	000
	£E.1,077,553	500

SPECIAL CREDITS.

LIST OF WORKS EXECUTED FOR OTHER DEPARTMENTS AND AMOUNTS SPENT UP TO 31st DECEMBER 1902.

	£E.	Mill.
Aswan water supply	1,015	943
Boulac Printing Office	1,923	000
Iron fencing, new garden at Kas-el-Nil Bridge	1,677	700
Mohammed Ali School	3,548	221
Fire Engines in Markaz	828	116
Markaz Baltim at Borollos	733	245
Excavation at Kom-el-Choukafa, Alexandria	774	425
Stables Markaz Kench	552	699
Bridge upon Djaffarieh Canal	694	916
Abbas School	576	810
New Native Courts, Cairo	657	882
Custom-House Stores, Damietta	525	000
Cemeteries in the Provinces	344	274
Custom-House Stores at Alexandria	71	206
Princes Block at Ras-el-Tin Palace	104	987
Place of Messageries, Suez	16	055
Latrines at Chihin-el-Kom	33	122
Amount kept as caution for works at Moses's Springs	16	952
Land for construction of a Tribunal at Faceous	150	312
Arab Museum	7,377	168
Markaz Beni Suef	13	950
Police Station, Pyramids	42	700
Paving Mudirieh Ghurbiieh	129	650
Furniture Mansour Palace	579	088
Police Station Barrage	115	199
Total	£E.22,533	370

CHIEF INSPECTION, SPECIAL BUILDINGS, LOWER EGYPT.

LIST A.—WORKS TAKEN OVER DEFINITELY DURING 1902.

Order.	Administration.	NAME OF WORK.	Date of completion.	Sum paid for works.	Cost exclusive of Architects' charges.	NAME OF CONTRACTOR.
				£ E.	£ E.	
A.	<i>General.</i>					
1		Egyptian Museum	4-9-1901	218,953	189,220	Gerozzo & Zafrani.
2		Geological Museum	27-5-1901	4,500	4,161	N. Marciano.
3		Lady Cromer Memorial . .	23-4-1901	3,676	2,683	A. Tréhiaki.
B.	<i>Custodia.</i>					
1		Alexandria Shed	25-7-1901	3,060	2,693	Padova, L. Rolin & Co.
C.	<i>Justice.</i>					
1		Shedin El Kom Summary Law Court.	5-7-1901	3,430	3,296	Ali Badoul.
D.	<i>Posts.</i>					
1		Cairo Post Office additions.	13-7-1901	12,100	11,550	Gnétin & Charvaut.
E.	<i>Sanitary.</i>					
1		New Pavilion Alexandria Hospital	29-4-1901	4,000	3,717	A. Tréhiaki.
				249,703	217,270	

*This figure does not include the cost of the following items:—

- (a) Competition designs.
- (b) Commemoration Medals.
- (c) Fees, etc.
- (d) Expropriation of British W. O. property.
- (e) Compensation for interruption of work.
- (f) Conveyance of collection from Ghizeh.

NOTES ON LIST A.

WORKS TAKEN OVER FINALLY IN 1902.

Of the seven works mentioned in this list there is little to be said ; few repairs of any importance were required when the buildings were definitely taken over after the year's guarantee.

In the *Egyptian Museum*, the enormous area (M² 2,500), of glass covered skylights makes the building very hot in summer and is a constant source of anxiety during the rainy months.

The summer heat cracks the paint and putty, and when the rain comes it is liable to find its way through these cracks. I am in favour of replacing all the glass-covered skylights by ferro-concrete roofs, and raising the sides to give sufficient light. This would make them similar to some already existing which are quite satisfactory. At present there is too much light and it is difficult to regulate it.

In laying out the Museum garden last October, it was found that the sodium chloride in the soil had eaten away the copper of the lightning conductors which had been fitted in August 1901 ; these were replaced and protected with asphalt.

The *Alexandria Custom Shed* has given some trouble through the corrugated iron roof leaking. The contractors are repairing this.

The *Cairo Post Office* foundations which were constructed in ferro-concrete have been entirely successful ; the building has stood for 18 months without the slightest settlement having taken place in spite of the extremely bad ground on which it is founded.

The cheapness and efficiency of this class of foundation for heavy buildings on treacherous soil will doubtless lead to its extensive adoption in this country.

CHIEF INSPECTION, SPECIAL BUILDINGS, LOWER EGYPT.

LAST B.—WORKS COMPLETED DURING 1902, OR STILL IN COURSE OF CONSTRUCTION.

Order.	Administration.	Date of completion during 1902.	Name of Work.	Date of commencement.	Expenditure.	Is Value of Construction.		Contractor.	Remarks.
						Before 1902.	During 1902.		
General.									
A—1		20-10-1902	Unemployment Works (Egyptian Museum)	21-3-1901	30,508	—	956	3,513	Guariso & Zaffrani.
2		3-1-1903	Reinforcement for Director General ..	17-7-1902	—	—	—	—	Do.
3		9-11-1902	Workshop and Sheds ..	20-7-1902	—	—	—	1,091	Do.
4		20-12-1902	Boundary Wall ..	7-10-1902	—	—	—	—	Do.
5		—	Police Quarters ..	—	—	—	—	2,304	Do.
6		16-9-1902	Sandara ..	31-3-1890	57,900	—	47,018	7,382	Minelli & Teshinski.
7		—	Arab Museum and Khedivial Library	28-9-1902	1,300	—	—	585	Do.
8		22-6-1902	Supplementary Works Arab Museum.	6-3-1901	10,000	—	2,835	4,314	Zaffrani, Anzicotti & Giambelli.
9		4-10-1902	Busine Stables ..	—	—	—	—	—	Do.
10		15-10-1902	Tania Tiazim Office ..	30-7-1901	2,100	—	600	1,093	A. Margonoff Bey.
B—1	Chadoma.	30-7-1902	Model Workshop ..	21-1-1902	11,093	—	—	9,139	A. Teshinski.
2		—	9 New Sheds on Alexandria Quay ..	20-6-1901	18,100	—	4,063	4,750	Poliva L. Rella & Co.
C—1	Infanterie.	—	Addition to Colonne Stores Alexandria ..	21-8-1901	10,585	—	1,935	12,519	Hennelque.
2		—	Cairo Central Fire Brigade Station and Police Barracks ..	7-10-1901	25,000	—	1,113	5,231	Guélin & Charvaut.
3		—	Completion Government Post-Office ..	31-8-1901	13,000	—	4,550	7,803	O. Guariso.
4		1-7-1902	Police Barracks Nava ..	20-10-1901	2,800	—	500	2,902	Guélin & Charvaut.
D—1	Justice.	20-12-1902	Police Barracks Kom-Hinnia ..	6-10-1902	3,370	—	50	45	Aly Badawi.
2		5-8-1902	Post-Office Summary Law Courts ..	20-12-1901	1,220	—	—	2,852	Boyer, Pappet & Co.
3		25-11-1902	Nadva Court, of Ab. Gaba, (Archives)	18-12-1901	2,140	—	—	1,896	Guélin & Charvaut.
E—1	Police.	—	Port-Office ..	14-3-1902	950	—	—	669	Mummarth & Ambrosoli.
2	Administration.	—	Sandara ..	11-8-1901	25,325	—	4,032	11,724	Guélin & Charvaut.
3		—	Sandara ..	1-9-1901	31,500	—	2,436	3,302	Iselle Antonini.
4		—	School of Law ..	21-7-1901	22,100	—	1,089	8,178	Mukar & Plogathi.
5		—	Shedded-Kom School ..	14-2-1902	8,000	—	—	1,220	J. Pommik.
6		20-9-1902	Three rooms on Abine School ..	17-8-1902	650	—	—	576	Zaffrani, Anzicotti & Giambelli.
F—1	Prisons.	—	Manicha ..	—	9,025	—	—	8,888	N. Pommik.
2		—	Lanta ..	—	2,412	—	—	1,802	Chizzo & Pedrigo.
3		—	As-Saradita ..	—	10,165	—	—	8,502	McClure & Darling.
4		—	Zarzizig ..	—	4,123	—	—	3,723	Chizzo & Pedrigo.
Total ..					313,055	E.L.	77,528	135,881	

NOTES ON LIST B.

WORKS COMPLETED DURING 1902 OR STILL IN COURSE OF CONSTRUCTION.

A.—General.

(1—5) Complementary Works Egyptian Museum.

Besides the Director General's house, the workshops, boundary wall and Police Quarters, these works comprise a house and office for the Secretary General, a monument and a statue for Mariette Pasha's Tomb, and a quantity of small works in connection with the main building, including painting of the exhibition rooms, construction of partitions, iron grilles, water closets, a lift, electric fire alarms, etc.

All these are finished with the exception of the Secretary General's house. This was not begun until after the opening of the Museum in November; it is now making satisfactory progress and should be finished by the end of July.

(6) Arab Museum and Khedivial Library.

This building which covers an area of nearly 4,000 M² consists of a basement and ground floor, for the Arab Museum, and a 1st floor and mezzanine for the Khedivial Library. The Museum has an area of over 1,900 M² (including corridors) for exhibition purposes and 4 rooms for the staff as well as the basement for workshops.

The Library, which has a separate entrance and staircase, consists of two large rooms for the storage of books, a large reading room for Europeans and a smaller one for natives, and 20 other rooms for manuscripts, maps, and for the use of the staff.

The work of the last 12 months has consisted chiefly in plastering, joinery, staircases and laying floors. Cement was specified for the greater part of the floors, but in order to obtain ornamental flooring at the same cost, the Kandarakis system of mosaic pavement was adopted after tests of an apparently satisfactory nature. After the mosaic had been laid for some weeks chemical action set in causing it to swell and crack to such an extent that all the floors so paved had to be demolished and relaid in cement as originally specified.

The same material was used for the balustrade of the Library staircase, but when the work was almost finished, it failed in the same way as the floors and had to be refused. It is now being replaced by ordinary imitation marble which should be finished by the end of February.

The entire cost of reconstructing the floors and balustrade executed in the Kandarakis system is borne by the contractor, but the delay caused by doing so much work twice over is regrettable.

The Arab Museum was handed over to the Wakfs Administration at the beginning of November, and the collection is now being transferred from the old building. The Khedivial Library, though complete with the exception of the staircase, will probably not be opened to the public till the glazed steel dustproof bookcases, which are to be ordered from Europe, have arrived.

Tenders were invited for these bookcases, which are to contain 50,000 volumes, in July last, with the result that nine offers, two English and seven Continental, were received. None of these were entirely satisfactory, the prices quoted being in every case above our estimate. The most favourable tenders were respectively from Messrs. Panzer, Tresor, and Lipman, all of Germany. These firms have since been invited to quote for an installation slightly modified with a view to reducing the cost, sample bookcases are to be sent with their tenders.

As soon as these tenders are received, the order will be placed with one of the three and the work will, it is hoped, be finished in a year.

The cost of the installation, which, besides the bookcases, is to include 44 steel, glazed show cases for the exhibition of manuscripts, will be about £E.8,000.

It seems that closed bookcases are not in general use in large libraries, open shelves being substituted. In consideration of the prevalence of dust in Egypt these were not considered sufficient. It is for this reason that the order has taken some time to place and that sample cases were insisted on.

(7) Supplementary Works, Arab Museum.

A credit of £E.1,300 was sanctioned for these works, the largest item of which is a pavement in cement tiles round the entire building costing £E.600.

This is now finished with the exception of a small portion at the South end which will be completed as soon as the proposed garden at that point is made.

The remainder of the £E.1,300 has been spent on the construction of partitions, doors, extra water-closets, lavatories, and similar small alterations and additions to the interior of the building to suit the requirements of the two services by which it is to be occupied.

This sum would have been very much larger had all the somewhat extravagant demands of these services been carried out.

(9) *Tanta Tanzim Office.*

The Tanta Tanzim Office was taken over last June, nearly 6 months after the contract date.

This delay was to a great extent due to the difficulty of getting materials delivered by the Railway Administration; but the contractor is also to blame and was fined £E.34.

The building provides offices for the Director of Works, Chief Engineer, and other Engineers and clerks, on the ground floor, with inspection rooms on the 1st floor.

(40) *Model Workshop, Boulac.*

This work was completed by Mr. Trébaki in the middle of October, 3 months before the contract date.

The building which covers an area of 2,650 square metres, is one storey high and consists of an erecting and fitting shop M² 420, with an engine room M² 66, attached; brass and tin workers' shops M² 75; leather workers, M² 145, carpenters and cabinet makers, M² 300; coach builders M² 125 and painters M² 180. The remainder of the space is occupied by lecture rooms for the apprentices, the necessary stores and offices.

The full establishment will consist of 100 artisans and 300 apprentices. In view of the probable growth of the institution the foundations and roof have been designed to allow of an additional storey being built.

The iron windows and entrance gates for the building were supplied by Messrs. Critall, of Braintree, England, and are much more suitable than the wooden ones originally specified.

B.—Customs.

(1) *9 New sheds on Alexandria Quay.*

These sheds, a description of which was given in my last year's Report, were finished last July. The upper portions of three of them have since been fitted with corrugated iron curtains and rolling doors as

a partial protection against driving rain, and a fourth has been entirely closed in with fixed sides.

(2) *Addition to Alexandria Tobacco Stores.*

The floors, roof and weight-carrying portions of the walls of this building were constructed in ferro-concrete. In order to avoid, as far as possible, fluctuations of temperature in the store, the roof was made double, with a closed air space between the two portions.

The work which was begun in August 1901 was put under Mr. Ehrlich's direction last April and subsequently completed by him.

C.—Interior.

(1) *Cairo Central Fire Station.*

The foundation originally specified for this building was a general bed of honra concrete 1 metre thick, but after excavating to a depth of 2 metres the ground was found to be honeycombed with old sewers and wells. It therefore became necessary to provide some very much stronger foundation, and after due consideration it was decided to adopt Messrs. Guétin & Charvaut's system of ferro-concrete, which had recently been used with such satisfactory results for the Cairo Post Office which adjoins the Fire Station.

The ground was accordingly levelled off at a depth of 2 metres, rammed and watered, the old wells having been previously cleared and filled with sand. The surface was then covered with a general bed of hydraulic lime concrete 25 centimetres thick. Next came a layer of sand 80 centimetres thick surrounded by a revetment wall to prevent its being forced out laterally; and finally, resting on the sand, the ferro concrete. The disposition of the latter was almost identical with that used for the Cairo Post Office and described in detail last year.

Messrs. Guétin & Charvaut completed these foundations in November last; the elevation masonry, for which Mr. G. Garozzo is the contractor, was begun almost immediately and is now progressing satisfactorily.

(2) *Completion of Governorat Port-Saïd.*

The ground floor of this building, which consists of a central block and two wings, is for the Government offices; the 1st floor will be the residence of the Governor General.

The West wing was built in 1899 and the remainder, which was begun in August 1901, is nearly completed.

For the rubble masonry, Old Cairo stone was specified, but the canal transport was found to cause so much delay, that the contractor was allowed to continue the building with Mex stone brought by sea from Alexandria. Artificial stone (see Appendix II) was also employed in the construction with satisfactory results.

The building would have been finished sooner but for the very frequent changes made during the progress of the work at the request of the Governor General.

(3) *Police Barracks, Nawa.*

This building is of the same type as the other "Merkazes" lately constructed in the provinces.

It has stabling for 10 horses. It was begun in October 1901 and handed over to the Ministry of Interior last July.

Here again railway transport was the cause of considerable delay and inconvenience, the quantity of trucks available for the conveyance of materials being as usual entirely inadequate.

The contractor, Ali Badawi, is the only native who has undertaken work for this Inspection for the past 3 years, and it is satisfactory to note that his work compares favorably with that of the European firms with which we have to deal.

(4) *Police Barracks, Kom-Hamada.*

This village is so inconveniently situated that there has been considerable difficulty in finding a contractor to undertake the work at a reasonable price. It was, in fact, only after two adjudications that the building was eventually intrusted to Messrs. Boyer & Parizot, whose tender, though high, was the most favourable received.

Work was begun in October last. The building should be finished in May 1903.

D.—Justice.

(1) *Port-Said Summary Law Court.*

This building was begun in December 1901 and finished just a year later.

As in the case of the Governorat, artificial stone has been introduced into the construction, being used for the main cornice and the decorations round the principal entrance.

The high boundary wall specified round the building has been replaced by an iron railing carried by a low wall, with artificial stone coping.

The bulk of the masonry is in Mex rubble stone and for the mortar and plaster, Theil hydraulic lime has been exclusively used, the ordinary lime of the country being unsuitable so near the sea.

(2) *Native Court of Appeal, Cairo (Archives).*

This building consists of only one floor. Besides the offices of the Native Court of Appeal, it contains two rooms for the registration of prisoners on the Anthropometrical system.

The building was handed over in August.

As is frequently the case with low buildings in a city, complaints were made by the neighbours of the smell from the cesspit ventilator. The late Governor of Cairo arranged with one of the complainants for permission to run the pipe up his building which was considerably higher on the opposite side of the road. This gave satisfaction until the man died. His heirs have now brought an action to compel us to remove the pipe.

(3) *Native Court of Appeal Cairo (Improvements).*

The "Improvements" consist of painting and distempering throughout the interior of the building, cement plaster round the bases of columns and pilasters, the extension of the east balcony, and sun shutters for the court rooms and consulting rooms.

Much has been written, and said, about these last; several kinds of blinds and shutters were suggested and tried, and several high authorities consulted before a definite decision was arrived at.

I believe the shutters eventually chosen cause as much satisfaction to the judges as disfigurement to the building.

E.—Posts.

(1) Post Office, Port-Said.

The ground floor of this building is used as a Post Office, and over part of this is a first floor which will be used as a residence for the Director.

Several changes have been made in the building since its commencement, the chief of these being the suppression of half the first floor, and the introduction of artificial stone, which has been used for the plinth, principal facade, pillars, cornices and mouldings.

The building is nearing completion and will probably be handed over to the Post Office Authorities in April 1903.

F.—Education.

(1) Sanieh School.

The contract for this building was signed in September 1901, but owing to the extremely bad nature of the ground and the consequent necessity of modifying the entire project for the foundations, a start was not made with the concrete until last August.

The new foundations are on the Hennebique system of "béton armé" lying on a general bed of hydraulic lime concrete. The whole is designed in such a way as to limit the maximum load on the ground to 700 grammes per square centimetre.

For these modifications a further sum of £E.4,300 has been allotted in addition to the original credit of £E.32,000.

The Ministry of Public Instruction have recently asked for various alterations and additions estimated at £E.4,000 of which the chief items are a house for the lady teachers, and a boundary wall to enclose the land added to the site since the original project was made. This sum has not yet been sanctioned.

The work is now well above ground level and is progressing rapidly; it will, I hope, be finished in June 1904.

(2) School of Law.

As in the case of the Sanieh School and of the Fire Station the ground here is exceptionally difficult for foundations.

The site was formerly occupied by native habitations. These were

pulled down at the time of the construction of Abdin Palace, the debris being used to raise the level of the ground.

The result is a layer of badly packed rubbish lying on wells, sewers and cesspits.

After excavating to the required level, the ground was thoroughly flooded to settle it and show the positions of the wells, etc. When these latter had been carefully filled up, and the whole foundation surface levelled off, a bed of dry concrete metal, 20 centimetres thick, was rammed, or almost hammered, into the soil, so as to form a more or less solid base on which to lay the general bed of hydraulic lime concrete $1\frac{1}{2}$ metres thick.

The difficulties connected with these foundations caused considerable delay, but once started, the work has advanced quickly and the masonry is now 6 to 7 metres above ground level.

(3) *Shibin-El-Kom School.*

This building was begun last February, and should be finished early this year (1903).

Since the signing of the original contract which only embraced the actual school, the Ministry of Public Instruction have asked for various supplementary works such as a kitchen, dining hall, prayer room, house for the Director, etc.

The necessary funds for the kitchen and dining hall (£E.2,200) have been found from economies on the credit for the school. The remainder of the works asked for have been put aside owing to lack of funds though the plans for their execution are ready.

(4) *Five Rooms for Abbas School.*

These rooms which are for the accommodation of new school-mistresses, were asked for late in the year and had to be completed before the beginning of October.

Mr. Annigoni undertook to finish the work in a month, and great credit is due to his partner Mr. Zaffrani who completed the contract up to time after Mr. Annigoni's death from cholera.

We have lost one of our best contractors in Mr. Annigoni; he was honest, energetic, and full of resource.

G.—Prisons.

As the list shows, work to the value of £E.23,015 has been executed at the Manshia, Alexandria, Tantah and Zagazig Prisons during the year under the general supervision of this Inspection.

PROJECTS OFFICE.

Until this year, all projects for works carried out by the different branches' of the Buildings Department were prepared by the Central Architects' Office under Manescalco Bey.

Under this system the Inspectors failed to keep sufficient touch with the Architects' Office so as to avoid changes in the designs during construction. The preparation of the new drawings embodying these changes could not be executed with sufficient promptitude to avoid in some cases prejudicial delay.

This is natural, seeing that the Architects' Office was occupied with much other work which was not laid aside in order to hurry on the changes. Owing to the transfer the Executive Department can now avoid these delays and thus escape the risk of claims for "*frais généraux*" which some contractors are so ready to make.

For works in progress this advantage has been amply exemplified in the case of the Model Workshop. The elevations were entirely changed after the commencement of the works, but though this change entailed many new designs there was no delay in the completion of the works although the contract time was very short.

Of the main object of the new system, however, it is early to speak as we are only just putting into execution the projects which have been prepared in 1902. The Inspectors feel convinced, however, that the result will fully prove the benefits of the new system, and will obviate those changes during construction which give opportunity to the contractors to make exorbitant claims.

This Office began the projects for 1903 on the 1st of March with the following staff transferred from the Central Office.

1	Architect.
4	Architect's draughtsmen.
2	Engineers.
4	Tracers.
<hr/>	
11	

Three of these can be relied on for original work; the capabilities of the remainder are limited to the making of detail drawing, modifying type plans, and tracing.

With this staff the office has turned out working drawings for 18 buildings under construction, including the Law School, Sanieh School and Fire Station, for each of which foundations were entirely remodelled. Projects for the following buildings to be constructed in 1903 were also prepared:—

- 1.—Nasrieh School (additions).
- 2.—Benha “
- 3.—School of “Arts et Métiers.”
- 4.—Shebin-el-Kom School.
- 5.—Abbas School (new works).
- 6.—Kasr-el-Nouzha School (alterations).
- 7.—Police Station, Delingat.
- 8.— “ “ El Aïf.
- 9.— “ Barracks, Tantah.
- 10.— “ “ Bilbeis.
- 11.—Moudirieh, Zagazig.
- 12.—Custom Shed, Damietta.
- 13.—Post Office, Shebin-El-Kom.
- 14.—Ports and Lights Office, Port Tewfik.
- 15.—Mixed Courts, Cairo (Annex).
- 16.—Summary Court, Benha.
- 17.— “ “ Tantah (repairs).
- 18.—Tanzim Office, Port-Said.
- 19.—Secretary General's House, Egyptian Museum.
- 20.—Annexes “ “

The total number of drawings completed between the first of March, and the 31st of December was 589 and the number of copies printed 4,000.

During the same period, the estimating staff which consists of:

- 1 Chief estimator.
- 2 Quantity Clerks.
- 2 Clerks.
- 1 Translator.

furnished:—

49 Schedules of prices, containing in all 1864 art.	
63 Abridged " " " "	2354 ..
63 Details of quantities " "	2354 ..
23 General specifications.	
36 Schedules of ironwork.	

The value of work paid for during the year was £E.135,881—or deducting for comparison the amount spent on Prisons, which was not given in last year's report, £E.112,866—as against £E.91,505 in 1901. This represents an increase of 23% of work although the expenditure of the Egyptian Museum has been small as compared with 1901.

The only increase in the staff to meet this accession of work has been one English architect, Mr. M. A. Slater, and one native clerk. Mr. Slater has had a good deal of experience in England which he is applying very usefully here.

APPENDIX I.

CHIEF INSPECTION, SPECIAL BUILDINGS, LOWER EGYPT.

TABLE SHOWING COST PER METRE SQUARE AND METRE CUBE OF BUILDINGS TAKEN OVER FINALLY SINCE JANUARY, 1898.

No.	NAME OF WORK.	Towns.	Total cost exclusive of Architects' Fees.	Surface covered.	Volume.	Cost per M ² .		Cost per M ³ .		Description.
						£.	E.	£.	E.	
1	Egyptian Museum	Cairo	140,220	11,160	255,130	10	955	0	731	2 floors, basement and boundary wall.
2	Annex to Abnès School	Cairo	5,014	1,133	5,185	3	519	0	962	2 floors and boundary wall, verandah m ² 4850, and wooden shed m ² 1281.
3	Native Court of Appeal	Cairo	55,170	4,310	88,720	12	800	0	621	2 floors and basement.
4	Matrouh Prison	Cairo	20,480	1,800	33,420	11	377	0	642	1 floors and boundary wall.
5	Mex Quarantine Park	Alexandria	8,803	835	36,285	0	966	0	242	Dwelling house, stable sheds, boundary wall.
6	Annex Caisse de la Dette	Cairo	2,162	250	2,310	8	648	0	928	2 floors and boundary wall.
7	Summary Law Court	Meluh El Kobra	2,121	353	2,435	6	008	0	871	2 floors and boundary wall.
8	West Wing of Gouvernorat	Port Said	1,778	400	1,025	7	963	1	187	2 floors and basement, verandah m ² 3240.
9	Hospital	Shedun El Kom	5,544	864	1,575	6	416	1	212	Ground floor and boundary wall, verandah m ² 535.
10	Slaughter House	Port Said	2,674	580	2,615	4	610	1	022	Ground floor and boundary wall, shade m ² 510.
11	Police Barracks	Tonkh	1,848	510	2,420	3	625	0	763	Ground floor, part 1st floor, enclosed court, stables m ² 470.
12	Police Barracks	Galloub	1,720	510	2,420	3	372	0	710	Ground floor, court, and boundary wall.
13	Slaughter House	Galloub	537	96	490	5	568	1	090	Ground and part 1st floor, court, stables m ² 396.
14	Police Barracks	Simbellaweb	1,767	510	2,825	3	464	0	625	2 floors, basement, boundary wall, verandah m ² 575.
15	House for Dr. Medical School	Cairo	3,573	320	4,310	10	131	0	752	Ground floor.
16	Custom House	Ismailia	753	184	1,325	4	018	0	568	2 floors.
17	Geological Museum	Cairo	4,161	606	9,600	6	864	0	433	3 floors.
18	Lady Cromer Memorial	Cairo	2,633	300	7,000	6	751	0	355	Ground floor and boundary wall.
19	Summary Law Court	Shedun El Kom	3,296	637	4,110	5	174	0	802	Ground floor, boundary wall, verandah m ² 100.
20	Trinidad Station	Old Cairo	937	206	580	4	548	0	846	Ground floor, verandah m ² 495.
21	Hospital Pavilion	Alexandria	3,217	609	4,110	6	108	0	793	Ground floor.
22	Post Office Addition	Cairo	11,560	1,872	14,900	6	109	0	775	Ground floor.
23	Shed for Customs	Alexandria	2,633	1,402	6,826	2	688	0	391	Corrugated iron shed.

N.B.—The volume of verandahs, wooden sheds and stables is neglected in calculating the rates per m² though their cost is included.

APPENDIX II.

ARTIFICIAL STONE.

The artificial stone manufactured by Mr. Guetin & Charvaut was used at the Port-Said Post Office, Gouvernorat, and Summary Law Court.

The proportions used in the mixture were:—

1 metre cube of sand.

150 kilogrammes of hydraulic lime

150 " " Portland cement,

where the material was subjected to heavy loads, the quantity of cement was increased to 175 kilogrammes.

The prime cost was estimated £E.1.600 per metre cube.

or including laying " 2.000 " " "

The artificial stone is manufactured in wooden moulds to the form required and afterwards laid in the same way as ordinary ashlar.

Occasionally it is made in position.

The following points are of importance:—

- 1.—That the sand be thoroughly washed so as to remove all salt, before being used;
 - 2.—That as little water as possible be employed in mixing;
 - 3.—That the blocks be laid in the same way they are manufactured, that is, with the rammed layers horizontal.
-

SPECIAL WORKS INSPECTION, UPPER EGYPT.

SCHOOL OF AGRICULTURE AND REFECTORY.

The building as completed is for 80 pupils. It covers an area of 2461 m² and cost £E.5.91 per m². It contains on the ground floor the class rooms, chemical, physical and botanical laboratories, reading room, museum, dark room and drawing office; in all 26 rooms.

The first floor contains the dormitories, infirmary, bath rooms, etc., in all 9 rooms exclusive of bath rooms and lavatories. The doors are all fitted with English locks, the doors being specially designed for these.

This forms an annex to the School of Agriculture and contains dining room for 80 pupils, dining room for native staff, kitchen, scullery, fitters' room, laundry, store room and lamp room, etc; in all 10 rooms. It occupies an area of 656 m² and cost £E.3.66 per square metre.

These two buildings, in one contract, were completed 9 months before contract time. English locks are fitted to all doors.

Principal's House.

This building contains on the ground floor dining room, drawing room, study, kitchen and store room. On the first floor there are 3 bedrooms, store room, bath room, etc. English locks throughout. The house occupies an area of 270 m² and cost £E. 7.42 for square metre.

This contract was completed 43 days before contract time.

The actual cost is:—

	£E.	MM.
Paid from Caisse Credit	1,815	582
„ by Public Instruction Ministry for verandahs	126	900
„ repairs budget drainage and hot and cold water supply.	59	706
Sandries... ..	1	400
Total... ..	£E.2,004	588

AGRICULTURAL SCHOOL.

Teachers' Quarters.

This building was designed for the accommodation of seven teachers. It contains on the ground floor: sitting room, mess room, kitchen and

stores with ample verandahs. On the first floor there are 7 bedrooms, 2 bath rooms, 2 water closets and 2 store rooms. The inner hall which contains the staircase and gallery is lighted and ventilated by a skylight on the terrace, 6 metres by 2 metres. All doors are fitted with English locks.

The building occupies an area of 379 metres square and cost £E.8.24 per square metre of ground occupied.

NOTE.—The Caisse de la Dette granted a credit of £E.22,000, for the School of Agriculture Refectory, Principal's House and Teachers' Quarters.

The total cost is as follows:—

	£E.	Mill.
The School of Agriculture and Refectory	17,056	493
Principal's House	1,816	582
Teachers' Quarters	3,124	298
Total... ..	£E.21,997	373

ASWAN WATER SUPPLY.

The reservoir, pumping station and pipe mains were completed and the reservoir filled on the 1st April.

The detailed cost to date has been:—

	£E.	Mill.
Engine pump and pipe mains, etc.	2,001	659
Reservoir	512	613
Pumping station, building	381	605
Room for engineer and stone revetment	94	189
Sundry works	10	702
Surveillance	135	000
Total... ..	£E.3,135	768

Engine, Pump and Pumping Station.—The engine is a Tangye's petroleum oil engine of 10 B.H.P. working a belt-driven geared horizontal pump of 12-inch stroke and 7-inch working barrel. Revolutions 42 to 44 per minute with a consumption of 0.52 litres of petroleum per H.P. per hour. The suction and delivery pipes are 6 inches in diameter. 36 m³ of water can be raised per hour from the river to the reservoir. The reservoir can therefore be filled in 3 hours' pumping. The distance from the river to the reservoir is 459 metres and the suction lift at low Nile is 8.66 metres. The water is delivered into the reservoir at a height of 32 metres from the centre line of pump. The distance from the pump to reservoir is 409 metres.

The lowest level of the river is R.L. 84.08 and the highest flood is R.L. 94.15. The centre line of the pump is 3.51 below H.F.L.

The 6-inch main delivery of a total length of 2,173 metres from the reservoir is carried down the slope of the hill, passes the back entrance gate of the Cataract Hotel, where a branch is taken off for the hotel water supply, runs across the railway line into the town and along the river front as far as the north end of the town. The Grand Hotel, mudiriyah, Government school and fountains are supplied and 22 buildings are now taking water from the main. The streets are watered by five hydrants and the inhabitants can take their supply from taps fixed at intervals on the main pipe.

The pumping station is a building 9×4 metres. It is built of granite rubble with brick facings and contains a room for the engineer in charge of the pumping station. A dwelling house for the engineer and his family is absolutely required and should be built at once.

The reservoir is built in brickwork and rubble masonry and has a capacity of 100m³ when full. It is covered in with a vaulted brick roof and has a gauge room adjoining.

A contract was made with M. Pagnon for the water supply to the Cataract and Grand Hotels. He pays £E.150 for a maximum of 7,500 m³ per annum. The contract is for 10 years and after this period may be renewed on the same terms. Should the quantity supplied per annum exceed 7,500 m³ per annum he will pay 15 mill. per m³ for the extra quantity supplied. The meter is to be checked monthly conjointly by the Government Engineer and the Hotel proprietor.

	£ E. Mill.
In addition to the	150 000
paid by M. Pagnon per annum, the amount paid by	
the inhabitants of Aswan amounts to per annum ...	135 120
(Population 13,005) Total earnings	<u>£E.285 120</u>

These earnings might be considerably increased by an extension of the pipes in the town.

At Kena the earnings amount to £E.14,500 mill. per month or at the rate of £E.174 per annum. Payment for water at Kena was stopped at the end of September and the inhabitants pay nothing.

The population of Kena is 27,478.

BENI SUEF MARKAZ AND POLICE BARRACKS.

This building is constructed on the type for Mudiriyah towns.

It contains special stallion stabling and a fire engine station of the standard design.

ESNA MARKAZ AND POLICE BARRACKS.

This is the first district Markaz built from the type approved by the Adviser to the Ministry of the Interior and the Inspector General of Prisons.

These Markaz buildings are now fitted up with the new type of mangers approved by the Chief Veterinary Inspector.

AYAT SUMMARY TRIBUNAL.

A summary tribunal was built at Ayat for the Ministry of Justice. It is of the type adopted for Egypt by the Commission appointed in June 1899.

In the Judicial adviser's report for 1899 he says, "At Suhag a new court house is in course of construction and will be opened this year. It has been built upon a model which is far superior to the previous ones, and this pattern should be adopted for all the summary courts hereafter to be erected."

The area occupied by this building is 638 m² and the cost has been £E.5.20 per square metre of ground occupied. Suhag Tribunal, built in 1900, cost £E.4.63 per square metre.

ZOOLOGICAL GARDENS, GIZEH.

Tropical House.

The building consists of a room 10 × 5 metres with double roof, porches with double swing doors, boiler room, room for attendant and verandahs. There are 2 ventilators each 1 metre in diameter at the gable ends having a hit and miss arrangement worked from inside by a long arm so as to regulate the temperature. The heating apparatus consists of a cottage boiler in the basement room and 7 patent hot-water radiators. The maximum heat is 140° with a minimum coal consumption. The minimum temperature required is about 70.

The total cost is as follows:—

	£E. Mill.
Building	461 035
Hot-water apparatus	121 954
Marble plate with inscription	5 200
Colouring walls	5 439
Painting pipes	6 000
Cases for animals and reptiles... ..	101 600
Total	<u>£E.701 228</u>

The cost per square metre exclusive of cuses and hot-water supply is £E. 5 per square metre. The house occupies an area of 96 m².

STABLES, MARKAZ AND POLICE BARRACKS, KENA.

New stabling only was provided here for 14 horses. This stable will form part of the new Markaz and Police Barracks when money is available.

The new type of manger has been adopted. For the first time, I think, in Egypt the Staffordshire blue brick has been introduced for stable flooring, asphalt having proved unsatisfactory south of Cairo.

These are laid on hydraulic concrete and jointed with Portland cement mortar. The cost per 1000 ex-Alexandria is £.10.7s.6d. against natural asphalt briquettes costing £.8.10s.0d. per 1000 in Cairo. The cost per square metre including concrete bed, was, at Kena £E.0.645 against natural asphalt briquettes which cost £E.0.470 per square metre.

The area occupied by this building is 183 m² and the cost per square metre is £E.3.210.

In addition to the stables, a fire engine room was built of the standard type. This will also form part of the new Markaz when built. There are now 10 of these fire-engine stations in Upper Egypt. A great many more are still required.

BEARS' HOUSE, ZOOLOGICAL GARDENS.

This building has been entirely remodelled from sketches supplied by the Director of the Gardens.

MAINTENANCE OF GOVERNMENT BUILDINGS.

Out of 176 Government buildings in the Provinces of Gizeh, Beni-Suef, Fayum, Minieh, Assiut, Girga, Kena and Aswan, 92 have been repaired at a cost of £E.4,941. A sum of £E.600, was given to the Ministry of the Interior to repair 30 of their Markaz and police posts by village labour under the orders of the Mamour. These are built in mud brick and are of inferior construction generally.

Extensive repairs were done at the Mudiriyah, Aswan; similar repairs were done at the Mudir's house, Suhag, and Edfu School. These old Mudiriyah buildings, Markaz, Police barracks and schools are in a most deplorable condition. Assiut is the principal town and it has the most dilapidated Mudiriyah in Upper Egypt. I regret that money cannot

yet be found to build the new Mudiriyah. The contract plans were prepared in 1896. Assiut contains also the worst Markaz and Police barracks in Upper Egypt.

I attach a list (sheet C.) of the repairs executed with their respective cost during the year under review; and also a list (sheet D.) of repairs in progress at the end of the year, which will be paid for in 1903.

I also attach a list (comparative) E. showing the repairs and their cost in 7 provinces in 1900 and 8 provinces in 1901 and 1902.

ABSTRACT.

PROVINCES.	Years.	Number of Buildings.	Number of Buildings repaired.	Cost of repairs.
				£ E.
7	1900	141	56	3,814
8	1901	166	54	1,558
8	1902	176	122	5,541

ESTABLISHMENT REPAIRS.

1st Section Tanzim Beni-Suef and 2nd Section Tanzim Suhag.

The supervision of repairs in Upper Egypt is divided between two Chief Engineers and their assistants. The Chief Engineer at Beni-Suef takes the Provinces of Beni-Suef, Fayum and Minieh; and the Chief Engineer at Suhag takes the Provinces of Assiut, Girga, Kena and Aswan. Gizeli is worked by a special Engineer in the Office of the Inspector.

TANZIM (MUDIRIYAH) ENGINEERS.

There are eight of these for the most part inefficient engineers in Upper Egypt. They are attached to the Mudirs of their respective provinces, and are to a certain extent under my orders.

I would recommend that a qualified surveyor from the Survey Department should go round these Mudiriyahs occasionally and teach them surveying as it should be done. The present work is very inaccurate.

SCHOOL BUILDING.

The school which Mr. Hewat designed and built at Esna in the year 1900 was very carefully studied in every detail. The dual system of

teaching, as required by the Ministry of Public Instruction was adopted. The floor area and cubic area per pupil, ventilation and all the latest improvements in school designed were considered. It may be described as on the corridor type. This is the normal type adopted in France and Germany. It is convenient, less expensive and preferable to the English type with a large central hall. The Public Instruction have expressed their satisfaction with the building.

The Assiut, Fayum and Beni-Suef schools are all designed on the same type, but have been greatly enlarged to meet the requirements of the Ministry of Public Instruction in large towns.

For the School of Agriculture the Public Instruction required open dormitories, and for the Polytechnic School open cubicles.

LIST OF THE STATE BUILDINGS IN UPPER EGYPT AND OF THE REPAIRS EXECUTED IN 1900, 1901 AND 1902.

DISTRIBUTION OF THE BUILDINGS IN THE PROVINCES.

PROVINCES.	NUMBER.
Minieh	18
Fayum	17
Beni-Suef	14
Ghizeh	25
Assiut...	23
Girgeh	21
Keneh...	33
Aswan	25
Total...	176

NUMBER OF THE BUILDINGS BELONGING TO EACH MINISTRY.

MINISTRIES.	PROVINCE.								
	Minieh.	Beni-Suef.	Fayum.	Ghizeh.	Assiut.	Girgeh.	Keneh.	Aswan.	Total.
Interior	9	8	9	11	13	12	14	11	87
Justice...	2	2	2	4	6	3	9	5	33
Public Instruction...	2	2	1	5	—	1	3	5	19
Finance	4	1	4	1	3	2	6	3	24
Public Works	1	1	1	4	1	3	1	1	13
Total...	18	14	17	25	23	21	33	25	176

INSPECTION UPPER EGYPT.

Statement C.

REPAIRS MADE IN STATE BUILDINGS OF 8 PROVINCES IN UPPER EGYPT DURING THE YEAR 1902.

	£E.	Mil.
Works executed by 1st Section of the Tanzim of Beni-Suef (Provinces of Ghizeh, Beni-Suef, Fayum and Minieh) ...	1,531	183
Works executed by 2nd Section of the Tanzim of Sohag (Provinces of Assiut, Girgeh, Keneh and Aswan) ...	3,324	578
Total of works executed and paid for in 1902 ...	<u>£E.4,855</u>	<u>761</u>

N.B.—Besides the above total, a sum of £E.600 was granted to the Ministry of the Interior to be used in repairs of 30 Markaz and Police Stations which are built with crude bricks and are generally of inferior construction.

Another list A is annexed, in which are shown the repairs in progress at the end of 1902 to be paid for in 1903.

LIST OF OLD MERKEZ AND POLICE POSTS WHICH ARE BEING REPAIRED BY VILLAGE LABOUR ON THE ORDERS OF THE MAMURS AND FOR WHICH A SUM OF £E.600 WAS HANDRED OVER TO THE MINISTRY OF INTERIOR.

Nos.	Merkez and Police Posts.	Nos.	Merkez and Police Posts.
1	Feshn.	16	Kous.
2	Edfon.	17	Kosseir.
3	Daraw.	18	Tenna.
4	Bassalich.	19	Soubag.
5	Silwa N.	20	Akhmin.
6	Aswan.	21	Baliana.
7	Abhur.	22	Mellawi.
8	Roda.	23	Tahta.
9	Abousir.	24	Abou Tig.
10	Ahnasia.	25	Assint.
11	Edwa.	26	Kerosko.
12	Abou Shousha.	27	Khiam.
13	Nag Hamada.	28	Embatuh.
14	Deshna.	29	Karfr Ammar.
15	Kena.	30	Manashli.

BUILDINGS COMPLETED IN UPPER EGYPT IN 1902 WITH THEIR SANCTIONED AMOUNTS AND ACTUAL COST.

Chief Inspector's Office, Tancin, Upper Egypt.

Number	Towns	Name of Buildings	Sanctioned Amount.	Actual Cost.	Economies.	Excess.	Date of completion.	REMARKS.
1	Gizeh	Police Station.	£E. MIL. 1,116,000	£E. MIL. 1,355,869	92,131	—	25th Jan., 1902	As Payable and payable Menu House Hotel.
2	"	School of Agriculture and Refectory.	17,053,400	17,053,400	—	—	30th Sept., 1902	Completed nine months before contract time, paid from Calais Credit £E.22,000.
3	"	Principal's House	2,000,000	1,916,292	2,627	—	31st March, 1902	Completed forty-two days before contract time, paid from Calais Credit £E.25,000.
4	"	Teachers' Quarters.	3,265,000	3,121,298	—	—	10th Dec., 1902	Completed contract time, paid from Calais Credit £E.25,000.
5	"	Entrance gates and Railway school of Agriculture.	—	103,058	—	—	20th Dec., 1902	Excess to contract, paid from Calais Credit £E.22,000.
6	Aswan	Reservoir and pumping station.	3,150,000	3,135,772	14,228	—	2nd April, 1902	For town, Cataract and Grand Hotel.
7	Beni Suef	Murine and Police Barracks	1,500,000	1,121,655	378,345	—	15th Aug., 1902	Economy due to let their rooms being abandoned by Ministry of Interior, etc.
8	Esin	Market and Police Barracks	2,817,000	3,055,120	—	238,120	15th Aug., 1902	The excess is due to non-transferable additional being made by the Interior and Prison Department and a valueless error in the plans amounting to £E.100.
9	Ayat	Summary Tribunal	3,250,000	3,271,223	—	16,223	15th Aug., 1902	Excess due to foundation called for D. G. Tuncin (sold by selling).
10	Gizeh	Tropical House, Zoological Gardens	700,000	701,928	—	1,928	18th Aug., 1902	Placed with let water building apparatus.
11	Kenn	Market and Police Barracks, stables only.	400,000	585,465	14,535	—	4th Sept., 1902	These will form part of new barracks when money is available to build it.
12	"	Fire engine station	—	117,707	—	—	11th Sept., 1902	Special credit £E.1,500 from Ministry of Interior.
13	Gizeh	Rehabilitating Bears' House, Zool. Gardens.	200,000	178,444	21,556	—	23th Sept., 1902	Paid from Calais Grant £E.7,000.
14	Beni Suef	Prison Laundry and Workshops	—	—	—	—	—	Superiority of materials and workmanship only. New apartment annals to follow, let Jan., 1903.
Total £E. . .			30,887,000	38,620,911	529,122	256,571	—	—

LIST OF BUILDINGS LET TO CONTRACT IN 1902 AND STILL UNDER CONSTRUCTION.

Number	Towns	Name of Buildings	Approximate date of completion.	Sanctioned Estimates.	Spent in 1902.	REMARKS.
1	Helwan	Meteorological Observatory	May, 1903	£E. 2,612	£E. MIL. 48,150	Survey Department. Ministry of Justice
2	"	Equatorial House	" 1903	337	"	
3	"	Transit House	" 1903	240	"	
4	Luxor	Summary Tribunal	June, 1903	3,500	"	
Total £E. . .			—	6,689	48,150	—

NORTH INSPECTION.

(SAID BEY CHOUCRY.)

REPAIRS AND TANZIM.

457 separate and distinct works were executed in 1902 at an aggregate cost of £E.26,710.

The most important items were:—

	£E.
Ministry of Interior	2,400
" Justice	1,000
Cairo Post Office	1,000
Public Works Department	2,150
Mohamed Ali School	4,500
School of Medicine... ..	1,500
Mudirieh Galioub	1,000

Most of the buildings now used as public offices have nearly completed the unnaturally short span of life to which faulty construction and persistent lack of funds for maintenance have condemned them. Very large expenditure on this head will have to be faced sooner or later.

The Zagazig Mudiriyah and the Chibin el Kom School which are in danger of collapse and are being rebuilt after only respectively 23 and 22 years' life, may be taken as fair types of the structures inherited from the days of Ismail Pasha.

The buildings now occupied by the Ministries of Finance, Interior, Justice, and Foreign Affairs, were constructed about the year 1874 for the Muffetish. After the disappearance of the latter they were confiscated by Ismail Pasha. They are less than thirty years old. The life of a first class building should be at least 200 years. I question whether the structures in question will last another 10 years.

The fact that cheap building is a form of extravagance is evidently not grasped by outside Administrations. On submitting estimates we are frequently informed that a Mudir or a local Sheikh is prepared to undertake work or get it executed at half the cost. This occurred in 1902 with respect to certain rooms to be built at the Mudiriyah of Mansura. Though in cases where amateur construction is permitted a proviso is made that the repairs which must of necessity be disproportionately high shall not fall on the Public Works Department budget, the system is, in my opinion, to be deplored as in any case it

is the State which has to pay the constantly increasing maintenance charges and to provide an annual amortisation of fund say of 3% against the normal $\frac{1}{2}\%$.

183 rukhsas for the working of quarries round Alexandria were asked for in 1902:—

	£ E. MIL
The dues received on this head amounted to	126.460
Dues for stone and lime represent	2,480.505
Total... ..	<u>£ E.2,607.965</u>

75 contraventions for illicit working were drawn up.

MAINTENANCE OF PORT-SAID ROADS FROM 1890 TO END OF 1902.

YEAR.	WATER.	GAS.	Roads and Gardens.	SUNDRIES.	TOTALS.
1890	300	1,600	1,000	—	2,900
1891	300	—	—	—	—
1892	300	1,950	2,342	20	4,612
1893	300	1,950	2,342	20	4,612
1894	300	1,950	3,100	20	5,370
1895	300	1,950	3,100	20	5,370
1896	300	1,950	3,100	40	5,390
1897	300	1,950	3,328	52	5,630
1898	300	1,950	3,328	52	5,630
1899	300	1,950	3,328	52	5,630
1900	300	1,950	3,840	52	6,142
1901	300	2,100	3,840	52	6,292
1902	300	2,100	4,840	52	7,292

Maintenance of the towns of Port-Said and Port-Tewfik devolves on the Suez Company who for this purpose receive a Government grant of £ E.2,122.

TABLERAU INDIQUANT LES VILLES QUI SONT SOUMISES AU TANZIM
ET CELLES QUI ONT DES COMMISSIONS MUNICIPALES OU LOCALES AINSI QUE LE
NOMBRE DES HABITANTS DES DITES VILLES

N ^o d'ordre	Noms des Villes soumises au Tanzim	Commissions Municipales ou Locales	Nombre d'habitants	OBSERVATIONS
1	Benha	Com ^m Locale	8,462	
2	Zagazig.	*	35,715	
3	Suez	*	17,173	
4	Mansourah . . .	Municipalité	33,580	
5	Talkha ⁽¹⁾	Néant	6,430	(1) Dépend du bureau de Man- sourah.
6	Damiette	Com ^m Locale	31,288	
7	Port-Saïd	Néant	42,065	
8	Zifta	Com ^m Locale	13,724	
9	Mit-Ghamr . . .	*	12,680	
10	Chibin-el-Kom .	*	20,512	
11	Menouf.	*	19,726	
12	Kouesma ⁽²⁾ . . .	Néant	3,747	(2) Dépend du bureau de Menouf
13	Tanta	Com ^m Locale	57,289	
14	Kafr-el-Zayyat .	*	9,854	
15	Mehalla-el-Kobra	*	31,100	
16	Damanhour . . .	*	32,122	
17	Rosette	Néant	14,286	
18	Alexandrie . . .	Municipalité	315,047	

INSPECTION EAST.

(MR. CHAPMAN.)

During 1902 the amount spent on the budget for repairs in the East Inspection has been as follows:—

						£E.	
A	Distributed	over	97	works	for	Ministry of Interior	2,039
B	"	"	64	"	"	" of Finance	1,791
C	"	"	36	"	"	" of Pub. Insts.	1,080
D	"	"	22	"	"	" of Justice	327
E	"	"	36	"	"	" of P. W. D.	515
			<hr/>				
			255		Total	...	<hr/> £E.5,752

The total cost of surveillance out of this sum has been £E.58 or a little over 1 %.

£E.3,486 were expended on alterations as shown:—

	£E.
Ministry of Interior	1,139
" of Finance	1,418
" of Public Instruction	676
" of P. W. D.	253
Total	<u>£E.3,486</u>

Sanitary work was responsible for

	£E.
Interior... ..	265
Finance	468
Instruction	208
Justice	10
Total	<u>£E.951</u>

Works carried out on special credits given for extensions, alterations and new buildings cost £E.8,071.

	£E.
Ministry of Interior	890
" of Finance	5,179
" of Instruction	215
" of P. W. D.	1,787
Total	<u>£E.8,071</u>

The total cost for surveillance out of this sum has been £E.230 or a little more than 2½ %.

As usual, constant complaints were received with regard to leakage of roofs. Those repaired number 100 and have cost as follows :—

	£E.
Ministry of Interior	973
„ of Finance	178
„ of Instruction	281
„ of Justice	260
„ of P. W. D.... ..	40
Total	<u>£E.1,732</u>

Many of these roofs were repaired by simply washing over with two coats of hydraulic lime, the first being very thin so as to enter into all the cracks. This method has proved very successful when applied before the winter. On this kind of work a sum of £E.643 was expended.

During 1902 a sum of £E.322 was spent on repairs of buildings occupied by the Quarantine Department in addition to works carried out by that Department.

During 1902 designs were prepared for 52 works at the request of different Ministries which, however, could not be carried out owing to lack of funds. The total estimated amount of these was £E.19,084.

INSPECTION WEST.

(MR. EHRLICH.)

In May 1902, following on the decentralisation ordered by the Under Secretary of State, Mr. Ehrlich was charged with the preparation and execution of designs for special works in addition to his duties as Inspector of repairs.

A great deal of time was spent on the designing of a new Palais de Justice in Alexandria. As the site chosen was on the line of the unfinished Quay that is on land as yet unreclaimed from the sea, considerable study had to be devoted to the question of foundations and a number of designs and estimates were prepared.

The question is now definitively shelved as the Courts have decided to continue to rent the building which they actually occupy.

The total number of works given out to contract in this Inspection is 245.

I would draw attention to the introduction in Egypt of cork bricks. We employed these with excellent effect on the first floor of the Coast Guard offices where the ground floor ceiling timbers would not have supported ordinary brick partitions. A square metre of cork brick nogging 11 c. m. thick weighs 10 kilog. against 100 kilog. for ordinary brick work. These bricks can be nailed, sawn or cut. The price is high—six to one as compared with brick, but very cheap in cases where their employment obviates the necessity of remaking a vast expanse of ceiling as in the case dealt with by us.

Attached are several statements of work executed.

I—WATER RAISING MACHINERY.—COST OF WATER.

Towns.	Population.	Total Budget.	H. M.	Drinking Water Pressure Pump in Inches.	Total lift in ft.	Approx Q litres per sec.	W. H.P. or E.H.P. litres X metres lift ÷ 75	Q M ³ lifted per hour.	COST IN MILLIEMES PER HOUR OP.					Cost per one E.H.P.	Number of inhabitants that can be supplied with drinking and house water at 20 litres a head 10 hours (percent pump).	
									Petroleum.	Waste cotton.	Grisso.	Driver's Wages.	Total.			
Benha	12,472	1,000	7 3	3	10·63	1·8	0·25	6·5	4·500	0·186	0·321	9·000	14·613	2·25	58·45	2370 26
Zifta	14,039	1,200	5 10	3	10·53	1·8	0·24	6·5	9·900	0·077	0·186	3·000	13·163	2·03	54·84	3250 23
Mehallat Kahr ...	31,791	1,200	2	6	9·24	7·2	0·83	26	10·000	—	0·240	8·300	—	—	—	13000 41
Kafr El Zayat ...	10,231	1,000	4	3	5·63	1·8	0·13	6·5	3·330	0·097	0·444	10·000	13·871	2·13	106·7	3250 32
Chilán El Kom ...	20,705	1,500	7	3	7·78	1·8	0·19	6·5	12·220	0·097	0·186	2·750	15·253	2·35	80·28	3250 16
Suez	17,173	2,217	6	3	—	1·8	—	6·5	—	—	—	—	—	—	—	3250 19
Zagazig	35,715	2,250	12	4	11·89	3·2	0·51	11·5	14·147	0·227	7·872	23·000	45·246	3·93	88·7	5800 16
Mansura	36,131	10,400	13	3	7·16	1·8	0·18	6·5	9·000	0·157	0·998	4·160	14·315	2·20	79·53	3250 9
Mir Ghumr	12,983	1,200	3 48	3	10·23	1·8	0·24	6·5	5·000	0·079	0·433	8·000	13·512	2·08	54·05	3250 25

II.—LIGHTING AND SUNDRIES.

Towns.	Area of road lighted.	Kind of lighting.	Number of lanterns.	Annual cost per lantern.	Annual cost for lighting total.	Annual cost of lighting per inhabitant.	Sundry Budgeted.	Sanitation expenses per inhabitant.	Reserve Fund.	Purchased Fuel-Tonnes.	Cost of Administration.
	M ²			£E. Mdl.	£E. Mdl.	£E. Mdl.	£E. Mdl.	£E. Mdl.	£E. Mdl.	£E. Mdl.	£E. Mdl.
Tantah...	165,000	Petroleum...	319	1,570	501,450	0.009	200,000	0.004	40	130,764	280,800
Mansourah...	194,000	Electric...	420	100 L.A.E. 300}	900,000	0.0249	—	—	—	38,350	99,000
Mit Ghamr...	59,409	Petroleum...	150	3,200	480,000	0.036	100,000	0.007	—	—	—
Damietta...	150,000	Petroleum...	330	0,742	251,653	0.008	275,120	0.008	214,312	14,742	—
Port-Saïd...	259,463	Gas...	538	6,000	2,928,000	—	—	—	—	—	—
Suez...	160,793	Mineral Oil.	202	5,521	745,365	0.043	200,000	0.0118	106,000	335,199	27,735
Zagazig...	100,000	Petroleum...	76	2,063	416,420	0.012	200,000	0.005	100,000	200,000	—
Benha...	35,000	Petroleum...	100	1,688	128,307	0.010	52,439	0.0042	61,474	30,977	49,800
Zifta...	89,500	Mineral Oil.	75	4,667	466,744	0.033	100,000	0.007	8,000	—	86,400
Chibin-El-Kom...	87,028	"	35	5,466	410,000	0.020	150,000	0.00741	57,300	463,000	198,000
Mersut...	32,604	"	100	3,070	175,000	0.008	100,000	0.00483	36,000	21,636	89,736
Mehalla Kobra...	65,525	Petroleum...	150	2,070	389,312	0.012	100,000	0.003	200,000	—	126,000
Kafr-El-Zayat...	78,500	"	180	2,165	325,000	0.033	100,000	0.009	5,000	—	84,000
Damanhour...	51,000	"	—	1,760	316,926	0.010	150,000	0.045	50,000	40,000	—
Assiout...	—	—	—	—	—	—	—	—	—	—	—
Minieh...	—	—	—	—	—	—	—	—	—	—	—
Kenah...	—	—	—	—	—	—	—	—	—	—	—
Beni-Souf...	—	—	—	—	—	—	—	—	—	—	—
Helwan...	—	—	—	—	—	—	—	—	—	—	—
Schag...	—	—	—	—	—	—	—	—	—	—	—
Assouan...	—	—	—	—	—	—	—	—	—	—	—
Ghiseh...	—	—	—	—	—	—	—	—	—	—	—
Ghirgeh...	—	—	—	—	—	—	—	—	—	—	—
Luxor...	—	—	—	—	—	—	—	—	—	—	—

III.—SUMS GRANTED TO LOCAL COUNCILS SINCE THEIR CREATION
IN 1894 TO 1902.

TOWNS.	1894	1895	1896	1897	1898	1899	1900	1901	1902
1. Damietta	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
2. Tarrak	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
3. Assiout	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
4. Mehalla El Kotra ..	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900
5. Mansoura	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250
6. Med. Fayoum	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250
7. Dammanhour	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
8. Zagazig	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250
9. Suez	1,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200
10. Chiblu-el-Kom .. .	—	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
11. Minieh.	—	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
12. Keneh	—	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
13. Bent-Souef	—	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
14. Benha	—	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
15. Zefra	—	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
16. Sohag	—	—	1,200	1,200	1,200	1,200	1,200	1,200	1,200
17. Mit-Ghamr. .. .	—	—	1,200	1,200	1,200	1,200	1,200	1,200	1,200
18. Kafr-el-Zayat .. .	—	—	1,000	1,000	1,000	1,000	1,000	1,000	1,000
19. Helouan	—	—	1,200	1,200	1,200	1,200	1,200	1,200	1,400
20. Luxor	—	—	—	400	400	800	800	800	800
21. Menouf	—	—	—	—	—	—	—	1,200	1,200
22. Assouan	—	—	—	—	—	—	—	1,000	1,000
23. Guizah.	—	—	—	—	—	—	—	1,000	1,000
24. Quergash	—	—	—	—	—	—	—	1,000	1,000
	17,150	25,950	30,550	30,970	30,950	31,350	31,350	35,550	36,230

CAIRO CITY SERVICE.

ROADS.

The year's work is shown on the attached statistical tables. Against £E.306,203 required for macadamising the whole street area of Cairo we have £E.20,000. Our maintenance budget stands at £E.15,000, whereas £E.95,997 would be necessary for the upkeep of the 2,823,523 square metres for which the Department is responsible.

A sum of £E.20,000 was granted by the Caisse for the construction of asphalt roads. The first cost price £E.1 per M² is therefore necessarily a high one and the area paved relatively small. £E.20,000 spent on asphalt gives an area of 20,000M² or say two kilometres in length. The same sum would have enabled us to pave 125,000M² in basalt or say twelve and half kilometres.

On 20 years' life, however, a basalt road is more expensive than one of asphalt as shown by the following figures:—

	BASALT.	ASPHALT.
	£ E.	£ E.
1st cost	0.10	1.00
Upkeep 14 years @ 0.035	0.49	0.00
Lifting 5 years @ 0.080	0.40	0.00
Remaking 1 year	0.10	0.00
Total £ E.	1.09	1.00

It is generally admitted that asphalt is hygienic, comparatively noiseless, does not produce dust or mud, can be easily repaired and is *facile princeps* for ease of traction.

The unfortunate convention entered into with the Tramways on 14th July 1896, by which Government was bound to repair the Tramway zone at a unit rate which resulted in a heavy annual loss expired in 1091.

We have since by agreement charged the Company with the exact cost price of repairs plus 10%.

A new wooden bridge was constructed over the Ismailia Canal at the request and at the expense of the inhabitants of the Kolali (Boulac) Quarter. Access to the Tewfikiyeh Quarter is hereby shortened by some 700 metres.

RAIN DRAINS.

We have completed the calculations of Zone N° 2 but they have still to be submitted to the Sanitary Department.

The approximate estimate of Zone 2 is as under:—

	£E.
21 Kilometres of 0·15 to 0·60 in diameter 300 gulleys	57,000
Main sewer, Klmilig... ..	18,000
Cutting through blind alleys... ..	15,000
Shifting water and gas mains	3,000
Man holes, sluices, etc.	2,000
Electric pumps station	2,000
Sundries	1,000
Compensation to House Owners	8,000
	<hr/>
	106,000
20% unforeseen	21,200
	<hr/>
Total... ..	<u>£E.127,200</u>

For the Zone now working £E.165 was spent on the purchase of 9 wash out sluices while expenses on staff labour and plant accounted for £E.704.

Of the £E.5,370 granted in 1901. £E.2,837 were spent in 1901.

2,114 in 1902.

Balance in hand: 439

Total... .. £E.5,390

Rod-el-Farag
Road to Post
of Cairo.

GESIREH GROTTTO.

This grotto was opened to the Public on the 21st November. The gate receipts for the period 21st November to 31st December only amounted to £E.13,061 mill. I trust that we shall do better in 1903.

CHOLERA EPIDEMIC.

Mr. Reboul, as Member of the Sanitary Commission, was charged with the erection of public taps. 22 of these were fixed in 16 hours, a tour de force for which credit is taken by the Sanitary Department (vide Lord Cromer's Report.) The Tanzim Service was charged with the entire working of these taps night and day. Mr. Reboul further carried out filling in of wells, surveying "echeches" and a further

considerable amount of work which had to be executed at high pressure.

334 wells were filled in the Abdin, Esbekiyeh and Boulac Quarters.

The Bulakiyeh Canal was filled in from the point of junction with the Ismailia to the Shubra road. The brunt of the work of surveying "eecheches" in the infected quarters fell on Mr. Kolheb, Ricordi, Andriozzi and Chaker, Fuad, Mursi and Gawdat Eff. The bonus paid to the Sanitary officials was refused to the above though their assistance was and will be in other epidemics indispensable.

KHALIG ROAD.

This road is now practically devoted entirely to tramway use since, owing to its tortuous nature and small width it was found necessary to prohibit carriage traffic.

It should, from its central position, form one of the main arteries of Cairo. A scheme for widening this road to 20 metres has been completed for some years.

The total area to be expropriated is 150,134 M². Of this only 41,839 is required for the road leaving 108,295 to be resold. The constant short curves in the road account for the above considerable differences, seeing that to attain a relatively straight line it will be necessary to demolish entire blocks of houses.

The actual cost of the new road should ultimately be approximately.

Expropriation	150,134 @	£E.2.250	...	...	...	...	...	...	£E.
Re-sale	108,295 ..	3.—	...	...	...	...	...	...	337,801
									324,885
Total...									<u>£E.12,916</u>

PROPOSED ROAD BAB-EL-FUTOUH, BAB-EL-HUSSINIYEH.

This cutting was proposed as long ago as 1870. It would pierce one of the most insanitary quarters of Cairo.

The approximate ultimate cost should be £E.240,500. Cutting Bab-el-Futouh to Khalig; approximate cost £E.52,262. Cutting Bab-el-Futouh Zaher, approximate cost £E.26,518.

CUTTING FAGGALAH, KANTARET-EL-DEKKEH.

This would join the populous centres of Faggalah and Esbekieh and would cut through the peculiarly foul and insanitary Coptic Quarter; approximate cost £E.107,289.

BLIND ALLEYS.

There are 350 of these in Cairo which serve as stores for rubbish and offal. In case of an extensive conflagration they entirely cut off all chance of escape as may be seen by a glance at a map.

ABBAS ROAD (New boulevard).

Now that the Pont Limoun station is on the point of being moved to the north bank of the Ismailia Canal I trust that the £E.25,000 required for the creation of a handsome boulevard 4 kilometres long may be granted.

NILE BRIDGE, OLD CAIRO TO GISEH.

At the request of the Under Secretary of State, a project and approximative estimate were prepared. The figures given are as under:—

	£ E.
Main bridge 500 metres long and 20 metres broad from Giseh to Roda Island	130,000
Two subsidiary bridges 85 metres long and 12 metres broad from Roda Island to Old Cairo... ..	30,000
Roads 2,300 metres long and 20 metres wide on Roda Island including expropriation	40,000
Total... ..	<u>£E.200,000</u>

KASR-EL-NIL BRIDGE.

Mr. Reboul has prepared an interesting project for substituting a steel superstructure of equal weight to the existing iron one but six metres wider. The project is quite feasible and worthy of attention, the approximate cost would be £E.50,000.

T NEW STREETS TO BE CUT IN CAIRO.

No. of plan.	NAME OF STREET.	AREA TOTAL.			ESTIMATION.		PARTS TO BE RESOLD.			Estimated final total cost of cutting.
		to be enforced in street.	to be resold.	to be expro- priated.	Mean cost sq. ft.	Sum.	Area.	Mean cost sq. ft.	Sum.	
					£ E. MILL.	£ E. MILL.	£ E. MILL.	£ E. MILL.	£ E. MILL.	£ E. MILL.
I	The Khadig	41,839	108,295	150,134	2.250	337,801	108,295	3.000	324,885	12,916
II	Babel-Fotonh, Babel-Husseinih	106,144	59,140	165,284	2.8863	477,060	59,140	4.000	236,560	240,500
III	Babel-Fotonh, Khadig . . .	22,597	8,462	31,059	2.500	77,648	8,462	3.000	25,386	52,262
IV	Babel-Fotonh, Zaher . . .	15,547	4,576	20,123	2.500	40,246	4,576	3.000	13,728	26,518
V	Faggenah, Kantaret-el-Dikkah .	29,971	12,595	42,566	2.500	170,264	12,595	5.000	62,975	107,289

Cutls de sue to be opened.....350.

Mean length 12.^m50, width 7.^m00.

To be expropriated 350^m × 12.^m50 × 7.^m00 =

4.^m375 2.500 10,937.

COMPARATIVE STATEMENT OF THE COST OF LIGHTING, SCAVENGING CARRO AND ROAD MAINTENANCE
AND HOUSE TAX REVENUE FROM 1895 TO END OF 1902 :—

YEAR.	REPAIRS.	EXPENSES FOR THE MAINTENANCE.			BUDGET progressive increase.	TAXES.	
		Lighting. £R. M.	Scavenging & Watering. £R. M.	Total. £R. M.		On house property. £R. M.	Progressive increase.
1895	—	20,909	17,577	75,747	—	56,000	—
1896	—	20,924	21,044	76,868	0.16 %	55,400	loss 1.07 %
1897	—	20,924	22,294	76,868	1.31 %	56,610	2.18 %
1898	—	20,924	21,372	76,594	loss 0.20 %	58,420	3.20 %
1899	Eslackieh 26,826	21,524	26,400	77,224	0.70 %	60,900	4.24 %
1900	Eslackieh 26,826	21,474	26,400	77,184	loss 0.06 %	63,700	4.60 %
1901	Eslackieh 32,145	21,714	29,160	80,184	3.88	66,190	3.90 %
1902	Eslackieh 2,484	23,714	24,641	83,284	3.86	93,690	41.55 %
Total increase during 8 years 1895-1902 :							
		on the maintenance... ..			9.65		
		on house taxes ... ..			... ..	58.6	

i. e. the ratio of the increase of the house tax has been 6 times greater than the increase of the credits for road maintenance.

FINANCIAL ASPECT OF CAIRO ROADS.

Total area of roads	Square metres. 2,803,482 17,500 2,820,982	Percentage of total area.	IF MACADAMISED PISTON CURT.		ANNUAL MAINTENANCE.		BUDGET.	
			Per M ²	Total.	Per M ²	Total.	First Cost.	Maintenance.
			£E.	£E.	£E.	£E.	£E.	£E.
DIVISION INTO CATEGORIES :								
Unpaved or earth roads	1,410,956	49.4	0.160	225,752	0.026	36,684	0	0
Inferior Macadam streets not maintained for want of funds	1,007,526	36	0.060	60,451	0.039	39,293	0	0
Good basalt Macadam... ..	385,000	14	0.160	exist	0.052	20,020	0	15,000
2,803,482								
Asphalt roads in course of construction ...	17,500	0.6	1.143	20,000	0 (for 20 years).	0	20,000	0
2,820,982								
95,997								
15,000								

A.—TANZIM ROKHSAS DELIVERED IN 1901 & 1902.

YEARS.	For Buildings and repairs.		For Occupation of the public way.		For Verandahs.		TOTALS.	RECEIPTS.
	Cairo.	Koubbeh and Matarieh	Cairo.	Koubbeh and Matarieh	Cairo.	Koubbeh and Matarieh		
								£ F. Mdl.
1902	2,181	5	123	—	52	—	2,361	1,023.772
1901	2,164	7	98	—	37	—	2,306	1,026.282

B.—EXPROPRIATION AND SALE OF ZIADET TANZIM.

YEARS.	EXPROPRIATIONS.			ZIADETS SOLD.		
	Areas.	Sums paid.	Price of M ² .	Areas.	Sums received.	Price of M ² .
1902	1,566.30	999,452	0.638	685.47	401,528	0.586
1901	2,186.63	1,604,386	0.734	1,834.83	895,866	0.488

E.—REPAIRS BY HAND-LABOUR.

Year.	Area required	Material.			Labourers.		Sukkas and fountain water carriers.		Carts.		Total Sum.
		Stone.	Sand.	Water.	Days.	Sum.	Days.	Sum.	Days.	Sum.	
1902 ...	245,748	8,120	2,180	2,546	12,915	649	2,814	165	3,574	494	2,622
		10,300									
1901 ...	219,504	7,580	2,033	2,714	11,179	559	2,413	149	3,495	614	2,472
		9,673									

F.

REPAIRS PER HAND-LABOUR.		1902.	1901.
1.	Depth stone per square metre	8,120; 245,748 = 0·033	0·034
2.	Proportion of sand per cubic metre of stone	2,180; 8,120 = 0·268	0·276
3.	Cube of water used of stone per cubic metre	2,546; 8,120 = 0·314	0·358
4.	" " per square metre required	2,546; 245,748 = 0·010	0·012
5.	Mean surface required per day of workman	245,748; 12,915 = 19·03	19·64
6.	Mean surface watered per day of fountain	245,748; 2,814 = 87·33	90·97
7.	Mean cube transported per day of cart	10,300; 3,574 = 2·882	2·421
8.	Land of cart per journey	24; 245,748 = 4·164	4·957
9.	Cost price of materials per m ² required...	1,314; 245,748 = 0·0054	0·0052
10.	" per labourer... ..	649; 245,748 = 0·0026	0·0025
11.	" per sukka and fountain	165; 245,748 = 0·0007	0·0007
12.	" per cart... ..	494; 245,748 = 0·0020	0·0028
13.	Total cost price	2,622; 245,748 = 0·0107	0·0112

G.—PERCENTAGE TABLE.

YEAR.	Material, stone, sand, water %	LABOUR.				Total %	Cost price per m ² . £ E. MIL.
		Men %	Sukkas & Funtass %	Carta %			
1902 ...	50.1	21.8	6.3	18.8	49.9	0.0107	
1901 ...	46.5	22.6	6.0	21.9	53.5	0.0112	

H.—STRAIM ROLLER REPAIRS.

YEAR.	Required area.	Material.			Labour.			Funtass.		Cartas.		Steam Roller.		TOTAL amount £ E.
		Stone.	Sand.	Water.	Days.	Sum.	£ E.	Days.	Sum.	Days.	Sum.	Days.	Sum.	
1902	31,180	2,838	565	984	3,130	179	179	115	17	572	74	89	105	871
		3,403												
1901	8,669	981	125	353	997	63	63	107	16	283	35	31	44	341
		1,106												

	1902		1901	
	2,838; 31,180=	0.001	0.113	0.113
1. Depth stone per square metre ...	565; 2,838=	0.199	0.127	0.127
2. Proportion of sand per cubic metre of stone ...	984; 2,838=	0.347	0.340	0.340
3. Cubic of water used per cubic metre of stone ...	984; 31,180=	0.032	0.041	0.041
4. Cubic of water used per square metre repaired ...	31,180; 3,130=	9.96	8.03	8.03
5. Mean surface repaired per day of workman ...	31,180; 115=	271.13	81.01	81.01
6. Mean surface watered per day of workman ...	34.03; 572=	5.949	3.908	3.908
7. Mean cubic transported per day of cart ...	24; 11,898=	240.7	3.971	3.971
8. Load of cart per journey ...	31,180; 89=	350.34	27.961	27.961
9. Mean surface rolled per day of steam roller ...	106; 31,180=	0.0034	0.0051	0.0051
10. Total mean cost price of rolling ...	871; 31,180=	0.028	0.039	0.039
11. Total mean cost price per square metre of repairs.				

J.—BASEALT REPAIRS.

Year.	Area repaired.	Material				Men		Furniture		Carts		Steam roller.		Kilometre tons		Total Amount.
		Stone.	Binding.	Water.	Sum.	Days.	Sum.	Days.	Sum.	Days.	Sum.	Days.	Sum.	per M ² of road.	per M ² of material.	
		C.M.	C.M.	C.M.	£R.	£R.	£R.	£R.	£R.	£R.	£R.	£R.	£R.	£R.	£R.	
1902	120,442	9,836	1,295	4,856	1,852	16,052	963	609	91	3,219	419	373	558	0.192	10.708	3,883
1901	97,103	12,719	1,557	4,000	3,263	12,104	727	594	100	2,587	440	233	694	0.865	6.965	4,224

	1902.	1901.
1. Depth stone, per M ² ...	9,836; 120,442 =	0.082
2. Proportion of material of aggregation per M ² of stone	1,295; 9,836 =	0.130
3. Cubic of water used per M ² of stone	4,856; 9,836 =	0.494
4. Cubic of water used per M ² repaired	4,856; 120,442 =	0.041
5. Mean surface required per day of workman...	120,442; 16,052 =	7.50
6. Mean surface watered per day of furniture...	120,442; 609 =	197.76
7. Mean cubic transported per day of cart...	11,131; 3,219 =	3.457
8. Load of cart per journey ...	24; 6,914 =	3.471
9. Mean surface rolled per day of steam roller ...	120,442; 373 =	322.90
10. Mean cost price of rolling ...	558; 120,442 =	0.0046
11. Total mean cost price per M ² required ...	3,883; 120,442 =	0.032

K.—PERCENTAGE TABLE.

Year.	LABOUR					Steam roller	Cost price per M ²
	Material, stone, water, binding %	Men %	Furniture %	Carts %	Total %		
1902	47.7	24.8	2.3	10.8	37.9	14.4	0.032
1901	53.6	17.2	2.4	10.4	30	14.4	0.043

L.—ROADS RECONSTRUCTED IN BASALT.

Year.	Area.	Material.			Work performed by carts.				Fauls.		Water.		Labour and inspection.		Sundry purchases and repairs.		Roller.		Tons & Kilos.		Total expenditure.
		Basalt.	Old stone.	Graveling.	Amount.	Wheeled.	Handing.	Earth or old stone.	Total.	Days.	Amount.	Value.	Amount.	Days.	Amount.		Days.	Amount.	Per M ² of road.	Per M ² material.	
1902	58,754	7,751	430	3,741	1,918	7,751	1,741	431	10,765	4,205	68	3,637	39	11,562	772	172	238	400	1,254	7,824	4,652
1901	55,619	6,707	3,999	1,261	1,790	6,707	1,261	1,262	9,960	2,216	70	3,332	27	9,442	568	69	266	505	0,005	4,204	3,949

	1901	1902
1. Depth stone per square metre	0.164	9,024: 58,754 = 0.154
2. Proportion of blinding per square metre of stone	0.158	1,741: 9,024 = 0.193
3. Cube of water used per cubic metre of stone	0.417	3,637: 9,924 = 0.403
4. Cube of water used per square metre of road	0.060	3,637: 58,754 = 0.062
5. Mean surface per day of labourer	5.90	58,754: 11,562 = 5.08
6. Mean surface watered per day of faulser	128.28	58,754: 458 = 128.28
7. Mean cube transported	4.178	10,765: 4,237 = 2.541
8. Load of cart per journey	2.879	24: 6,092 = 4.722
9. Mean surface rolled per day	240.09	58,754: 248 = 240.09
10. Mean cost price material per square metre	0.0806	1,918: 58,754 = 0.0327
11. " " workmen	0.0102	772: 58,754 = 0.0131
12. " " carts	0.0163	684: 58,754 = 0.0116
13. " " faulser and water	0.0017	97: 58,754 = 0.0017
14. " " sundry purchases	0.0011	172: 58,754 = 0.0029
15. " " roller	0.0091	409: 58,754 = 0.0070
16. Total mean cost price	0.0710	4,652: 58,754 = 0.0790

* Limestone.

2.—REPAIRS OF KERBS.

Year.	Kerbs.			Materials.						Daily labour.				Carts.		Total.
	Old. Total length.	New. Total length.	Sum.	Lime.	sand.	Hours and cement.	Water.	Sum.	Mason.	Stone-cutter.	Labourers.	Sum.	Days.	Sum.		
1902 ...	12,135	1,627	239	2	32	1	8	6	327	319	755	119	7	1	365	
	13,762															
1901 ...	16,226	1,317	165	2	50	4	24	12	386	398	829	137	43	7	321	
	17,543															

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NEW KERBS.

1,458 l. m. of new kerbs have been constructed in the following roads at the cost of £E.411, i.e., at 0.287 Mill. per metre.

	l. m.	£ E.
New Arab Museum	356	97
Bab-el-Khalk	202	50
Kabouch Street	151	43
Haret Melakine	44	12
New streets at Abdine	556	177
Colonel's House	101	19
Setti Meska	48	13
	<u>1,458</u>	<u>411</u>

In our estimates we calculate the cost of the lineal metre all included at £E.0.300 Mill.

R.—PUBLIC GARDENS.

DESCRIPTIVE.	Year.	Number of		Inspection.		Hills.		Labourers.		Gardens.		Cuts.		Fences.		Mould.	Water by A. & Subba.		Total amount.
		Trains.	Foots.	Number.	Amount.	Number.	Amount.	Days.	Amount.	Days.	Amount.	Days.	Amount.	Days.	Amount.		Cuts.	Amount.	
Watering trees	1902	90,402	—	—	—	1	46	2,602	129	—	—	—	—	2,414	302	—	40,508	350	891
	1901	106,920	—	—	—	1	36	2,103	119	—	—	—	—	2,464	378	—	40,040	374	897
Pruning, up-keep of trees, planting, potting, etc. . .	1902	9,878	—	—	—	1	46	7,454	377	1	36	777	163	—	—	1,187	—	—	945
	1901	9,771	—	—	—	1	42	6,116	309	1	36	764	129	—	—	1,830	—	—	764
Gardens and Squares . . .	1902	—	—	—	—	2	85	7,221	371	2	58	—	—	—	—	1,017	40,676	773	1,579
	1901	—	—	—	—	2	78	7,063	397	2	54	145	46	—	—	1,035	40,100	721	1,906
Chesham Grove	1902	—	—	—	—	—	—	—	—	—	—	—	—	—	—	425	—	—	—
	1901	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fountains	1902	—	—	—	—	1	7	—	—	—	—	—	—	—	—	—	—	—	52
	1901	—	—	—	—	1	102	—	—	—	—	—	—	—	—	—	—	—	239

132,902 m³ — employed for garden 26,421 =
 156,312 " — " 26,421 =

* Of which 793 new trees planted against 302 in 1901.

Gardens and Squares.

Area per workman per day	99,178	7,921	13,79
Cost price per M ² in labour, gardians and inspection	108+85+374+58	99,178	0-0003
Cost price per day of cut	99	99,178	0-0007
Cost price per plants and supplies	112	99,178	0-0011
Total cost price per M ² (for Nos. 13, 14 and 15)	306	99,178	0-0081
Cuba of water used per M ² per annum	96,676	53,000	1-824
Cost price watering per M ² per annum	773	53,000	0-0146
Total cost price per M ² including watering	0-0081+0-0146	—	0-0227

1901

1902

1903

1904

1905

1906

1907

1908

1909

S.—QUARRIES.

MATERIAL.	Tourah and Old Cairo.	Abbassieh.	Abou Zaabal.	Total.	Sand, Abbassieh.
	M ³	M ³	M ³	M ³	M ³
1902. Road metal and sand ...	2,695	7,542	16,278	26,515	8,010
1901. " " " ...	1,543	9,464	18,138	29,145	6,574

BUILDING ALIGNMENTS EXPROPRIATION

AND

TANZIM REGULATIONS.

NOTE ON STREET ALIGNMENTS AND EXPROPRIATION.

The application to any town of Tanzim Regulations confers on Government the right of cutting wide streets through inhabited quarters if, as is usual, these are intersected by narrow and tortuous lanes.

On the plans of such towns is drawn an imaginary network of streets following as far as possible the existing lines but introducing modifications answering to the requirements of hygiene and traffic. The plans of the agricultural or other land unbuilt on but in the immediate neighbourhood of towns should also be marked out in a network of projected streets to enable us to regulate and control building extension. The introduction of the Tanzim and the official decreeing for public utility of streets involves however a liability to purchase property; such purchase becomes compulsory whenever a building permit is asked for on a road plotted but not constructed and not situated on Government land.

To avoid heavy expenditure on expropriation, alignments have hitherto be drawn to the minimum road-width compatible with hygienic requirements, that is to four and six metres. As practically no funds are granted for street improvement we have found it impossible to attain even this modest consummation.

The Ministry of Interior have lately requested that in the interests of public health and security no roads should be of a less width than 8 metres. I would do further and fix the minimum at 10 metres so as to admit of a 6-metre carriage way and two footpaths of 2 metres each. It is necessary however to point out that the plotting of street alignments is useless as long as funds are not available to meet the expenditure required for purchase of the streets. Land for the establishment of streets in the vicinity of towns other than Cairo and Alexandria could probably be bought for from £E.60 to £E.150 per feddan. Streets which have to be cut through an inhabited quarter such as are springing up without rule or order would cost from P.T.40 to P.T.150 per sq. met.

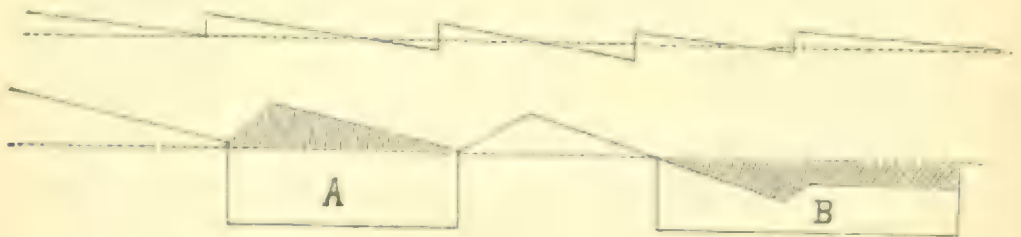
or from £E.1,680 to £E.6,300 per feddan. The loss which will ultimately accrue to the Government (for roads must be made if epidemics are to be combated with any chance of success) may therefore be reckoned by thousands of pounds per kilometre. As a case in point I would quote the case of Zagazig in which a quarter of the town has sprung up without let or hindrance from Government and which is at present not subject to the *Tanzim*. If the roads in this quarter had been bought as agricultural land they would have cost for 10 metres width £E.832. At present the widening alone from 4 to 10 would cost £E.13,898.

I have endeavoured to make it plain that the rule and regulations affecting building operations must remain a dead letter until funds are granted to admit of their practical application.

We have in our budget at present for Cairo £E.700 for expropriation.

The mean sum required annually to meet the cost of expropriations which we are forced to pay to proprietors required to conform to a decreed alignment amount to say £E.2,000 for Cairo.

The process may be best explained by a diagram.



The dotted line indicates an imaginary alignment drawn through the frontage of existing houses. The owners of A and B ask for a permit to repair the frontage. This permission cannot be refused and can only be given on condition that A withdraws and B advances his frontage to the red line. In the case of A, Government is forced to buy the shaded portion immediately, on pain of a law suit and condemnation for delay in delivering the permit.

In the case of B it was held until lately by precedent and by analogy with French and European law that the owner was obliged to purchase the shaded portion from Government.

A bewildering judgement however of the court of 1st Instance, December 1902, has decreed that the owner of B is not liable. Formerly therefore the expense of expropriation was met in part by revenue drawn from sales of "Zinet Tanzim" resembling B. Now owing to the eccentricities of Egyptian law the whole cost of any ameliorations tending to further the requirements of hygiene will fall on Government.

The system of estimating the value of relatively A and B is, in my opinion, very faulty. As is estimated by a commission presided over by the Chief Engineer of the Tanzim and Voirie. The value of B is assessed by the Governor of Cairo as head of a separate and distinct commission. Contiguous plots may therefore be valued at totally different rates. While the liability to pay for A falls on the meagre Voirie budget, causing an average deficit of £E.1,300 per annum, any sum encashed for B are absorbed by the Finance Department.

We are thus in a position immeasurably inferior to that of Alexandria.

I am informed that £E.40,000 was spent on roads in Alexandria in 1902 against £E.15,000 available in Cairo.

The sum allotted for expropriation in the villages is £E.500.

Assuming that a square metre of road may be bought for only P.T.10, this would allow us to expropriate 5,000 square metres per annum.

Taking only 8 towns in Upper Egypt and neglecting the 14 Municipalities of Lower Egypt we arrive at the following figures:—

Total length roads of eight towns.	Average width now.	Width after modification.	Area to be expropriated.	Cost @ 10 P.T. the M ²
M.	M.	M.	M.	£E.
143,207	4	8	572,828	57,282

Even therefore at the ridiculously low rate quoted above a period of 114 years would elapse before the streets of the main towns of Upper Egypt alone could, with our present budget allowance, be brought up to the standard laid down by the Sanitary Department. I trust that the Government may see its way to assigning certain revenues such as the dues for "occupation de la voie publique," which if properly administered could be trebled, to a work which from a Public Works, Sanitary and Public Security point of view is of the first importance.

EXPROPRIATION.

The following approximate figures will give an idea of the rate at which the opening up and widening of Cairo streets is progressing. They refer to the native quarters only.

The road area of the native quarters equals 1,457,522 square metres divided as follows :—

	Length.	Area.
Roads 4 M. wide	156,163	621,652
" 6 M. "	52,054	312,326
" 8 M. "	30,041	312,326
" 10 M. "	20,822	208,218
Total	258,080	1,457,522

The area of the above roads should be increased respectively by a percentage of 21, 20, 8, 5. The area to be expropriated would therefore be :—

Roads of 4 Metres	131,177	Sq. Metres.
6 "	62,465	"
8 "	24,986	"
10 "	10,411	"
	229,039	Sq. Metres.

In the five years from 1898 to 1902 we have been able or rather forced to expropriate 7,900 square metres at a cost of £E.5,800 or £E.1,160 p.a. As the sum granted is only 700 the balance of 560 had to be taken from our roads budget.

It appears therefore that 229,039 square metres have to be expropriated and that our maximum rate of progress is 1,580 square metres p.a.

Assuming a constant rate Cairo may expect to be "Haussmannised" or endowed with proper thoroughfares in ($\frac{229039}{1580}$) 145 years.

CART SERVICE.

The cart service commenced the year with an establishment of 118 animals. No increase has been made.

During the year 2 animals were sold and 4 died or were destroyed. ^{Animals.} These were replaced by others purchased through the Veterinary Department.

The daily percentage of animals sick and under treatment was 4.4, 1.9, being due to carelessness on the part of the drivers when at work. During the first 4 months of the year the daily percentage of sick animals under treatment was as high as 7.5 of which 4.0 was the result of accidents. Specially severe measures were taken to hold the drivers responsible for accidents to their mules, with the result that, for the latter 8 months of the year, the daily percentage of sickness caused by accidents was only 0.75. It speaks well for the care taken of the animals that the percentage of sickness from ordinary causes was only 2.12 during these 8 months.

The transport of stone and sand across the deep sand of the Abbas- ^{Transport.} sieh quarries to the roadway has always been a great strain on the mules. Two died from internal rupture caused by this class of work—one animal in fact falling dead in its tracks.

A Decauville line has just been installed and the material is now transported from the quarries to the side of the road, thus greatly lessening the strain on the animals.

An experiment in transporting by large double wagons is being made and so far has given good results.

For long distance transport the large wagons are best suited and are easier on the animals : they are also more economical. For work in the City the small single carts are best adapted.

During the cholera epidemic 30 animals were taken by Sanitary Services on loan. This much delayed our transport and recourse had to be made to outside contractors.

It should be noted that such a course is anything but economical where the lending Department has no spare mules.

The average daily cost of Tanzim mule and cart complete, including ^{Cost.} forage, driver and all other expenses, is P.T. 14, against the charge of P.T. 20 to P.T. 25 for outside carts.

The extra cost of hired labour has of course ultimately to be borne by the Department which from a mistaken view of economy borrows from our stables. We had this year considerable difficulty in recovering the extra money we were obliged to spend, an appeal having been lodged at the Finance against our charges.

Establishment. It is estimated that 20 more animals are necessary for the transport of the material required for roadmaking and repairs. This would mean an initial cost of about $20 \times 25 = \text{£E.500}$, and a yearly sum of £E.1,000 for maintenance. As the employ of our own carts would effect a saving of from 35 % to 40 % this extra expenditure would soon be recouped. At present, recourse must be had to outside contractors for the transport of a portion of our material.

The shoeing of the animals was carried out by the Veterinary Department in the Scavenging and Watering stables, but an arrangement has been made that from 1st January 1903 it will be done in our own stables under Veterinary supervision. It has already been found possible to make a comparison of the result this change effects.

In 1902, when our animals were shod by the Veterinary Department, the cost per animal was 95 mills. in January and 135 mills. in February.

In 1903, the shoeing being done in the Service stables, the cost inclusive of all expenses has worked out at 45 mills. in January and 43 mills in February, or about 50 % and 70 % cheaper than in 1902.

Heretofore, the animals were shod in the mornings, with the result that the best part of their working day was lost. This delay no longer exists as the shoeing is now done in the afternoons at the end of the day's work.

Repairs. It has been found more satisfactory to carry out the light repairs to carts in the stables, the heavy and difficult work being sent to the Arsenal as usual.

Receipts. The receipts for work done, stores supplied, animals hired, etc., to outside Services, amounted to £E.1,165 .

Staff. I would bring to notice the good work done by the Stable master, Mr. Potheary, a highly certificated military farrier and saddler, with 13 years' experience of military stables, whose care of the animals, etc., has been unremitting.

GAS SERVICE.

The total number of gas lamps in Cairo is 3,500 or an increase of Lamps. 257 since 1901.

The budget was increased by £E.2,000 in 1902. This increase is Budget. only sufficient to pay for an installation of 298 lamps for one year. In other words, for every £E.2,000 added to the Gas Budget about nine kilometres' length of streets can be lighted.

There are more than 400 kilometres (250 miles) of streets in Cairo and its suburbs; of this length only about 100 kilometres (62 miles) is now lighted. Two hundred kilometres are in urgent need of illumination. For this purpose 6,500 more lamps are required. At the present rate £E.43,500 would be required per annum for this purpose. Additional lamps required.

Demands for street lighting are daily received and in these petitions weight is always laid on the supposed fact that the residents in the quarters not yet lighted pay the same house tax as those resident in the more favoured quarters. Petitions.

The question of introducing incandescent burners for street lighting, instead of the "batswing" burner actually in use, was again brought forward by this Department. Incandescent lighting.

The Company, however, demanded a sum of 40 fcs. for each lamp converted, or a total of about £E.5,600. By the use of the "Auer" incandescent burner an effective economy of 25 % in the gas used can be made and it was pointed out to the Company that this saving should compensate for the expense of installation. No decision was arrived at in 1902 but at the time of writing I have hopes of being able to prevail on the Company to accept our proposal and effect the necessary alterations at their own expense. (*)

Several alternative schemes for largely extending the lighting of Cairo while offering facilities for payment and a reduction of the unit rate were presented by the Secretary General of the Lebon Gas Co.

Stated shortly, the Company offer to erect a given number of lamps at a reduced unit rate with payment deferred for the number of years during which the Contract has still to run.

(*) This hope is now realized (March 1903).

At the expiration of the Contract, Government will then owe the Company a certain accumulated sum. In exchange the Company ask for an extension of Concession, and are prepared to accept in extinction of our debt the total annual sum paid for lighting and not only the profit arising therefrom.

Such sum, therefore, divided into the accumulated debt will equal the number of years for which the Concession must be prolonged.

Fines.

During 1902 the Gas Company was fined £E.200.542 mill. for defective lighting, i.e., for 586 lamps found extinguished (=1.6 lamps per night or 5/100 % of the total lamps) and for 7,723 lamps (=2.1 per night or 6/100 % of total lamps) which gave less than the standard flame. In all, an average of 120 lamps, or 3.5 % of the total lamps, were reported nightly as being defective, but, as a fine is not imposed until the second night, the state of only 7,723 lamps, as above stated led to the infliction of fines.

It must be said in behalf of the Gas Company that great care is taken to avoid defective lighting. Regular repairing gangs are at work each night and defects are remedied as far as possible on the spot.

The absence of proper apparatus has hitherto rendered the application of accurate tests for quality impossible.

A laboratory now exists and will soon be fitted with the necessary appliances.

Lamps added
since 1890.

The following is the detail of lamps added during last 12 years:—

1890	...	...	...	...	...	...	...	...	...	3
1892	...	...	...	...	...	...	...	...	...	77
1893	...	...	...	...	...	...	...	...	...	198
1898	...	...	...	...	...	...	...	...	...	89
1901	...	...	...	...	...	...	...	...	...	62
1902	...	...	...	...	...	...	...	...	...	257
Total										686

at an approximative cost of £E.4,600.

Extension of
the hours of
lighting.

At the request of the Minister of the Interior and in the interest of public security the period of lighting has been extended by half an hour. This extension entails an extra expenditure of £E.673 per annum.

Staff.

Mr. FitzPatrick is charged with the control of this Service and has done his work excellently.

Mr. Mégalogéni's services have also been valuable.

LIGHTING SCHEDULES.

In connection with the street-lighting of the provincial towns which should be regulated according to the phases of the moon as regards the hours of lighting and extinction, an accurate time table and a series of curves have been elaborated by Mr. Jacot's Office.

Owing to the sub-tropical position of Lower Egypt the absence of clouds and the light colour of the buildings, the moon for many nights gives all the light required. Advantage has been taken of this fact so that Companies provide none, or only reduced artificial light for a number of nights before and after full moon.

Hitherto no scientific system has been followed, the town being on occasions left in complete darkness for hours. As no correct table existed giving the moon's phases for Egypt, it was difficult or impossible for the Companies to draw out proper schedules in advance.

Mr. Jacot has therefore, in order to establish a scientific basis, worked out curves for the approximate time of moonrise or set for every night of the year, and combined with them the curves for sunset and sunrise, so as to show at a glance every change.

Additional curves for each month, drawn within the above enclose a space representing what may be called sufficient moon-light, taking into consideration the height above the horizon to which the moon must rise to afford adequate illumination.

From these curves any lighting schedules can be elaborated by inspection.

In Helwan every advantage is taken of moon-light.

The lighting of this town is effected by electric glowlamps, one 16 c. p. lamp and one of 10 c. p. being fixed on every standard. On the 15th of February, e.g., both lamps are lit at 6 o'clock, $\frac{1}{4}$ of an hour after sunset. At 8.30, when the moon rises, the 10 c. p. lamp is extinguished, and at 10 p. m. the other lamp also can be turned off, as the moon is then standing high enough to give sufficient light for the rest of the night.

TRAMWAYS.

CAIRO TRAMWAYS.

On the 24th of May a new line was opened to traffic, starting from the Kasr-el-Nil Square, running past the Egyptian Museum, and the Ismailia-Canal, and joining the Fagalla line at Bab-el-Hadid (Railway Station). The whole line of $2\frac{1}{2}$ kilometres is double.

Owing to the increase of traffic on the first section of the Pyramid line, the track was doubled from the terminus at Kasr-el-Nil Bridge to Giza village.

In August the overhead bridge across the Upper Egypt railway-line, which with its long approaches forms a cumbersome and disfiguring erection, was finished. This replaced the former level crossing which in spite of the precautions taken such as electric cut off, etc., was considered dangerous by the Railway Department.

The work was carried out by the Railway Administration, the Tramway Company contributing £E.1,300 to the cost.

On June the 3rd, Government approved a project for the construction of a new line from Bab-el-Hadid or the Central Railway Station to the new Quay at Rod-el-Farag below Embabelh; this line follows the Shubra road for a length of 2 kilometres then turns at right angles towards the river and terminates at 4.150 kilometres from the starting point. A great portion of the track is now laid.

The working of the tramways has been very satisfactory and no abnormal irregularity has occurred.

Statistics regarding the extension of lines and the development of traffic and financial data are attached. The favourable results shown may be partly ascribed to the fall in the price of fuel and partly to an increase of receipts.

STATISTICS.

	YEAR ENDING.	
	June 30th, 1901.	June 30th, 1902.
I.—GENERAL.		
Length of concession	50 years.	
Date of expiry	1946	
II.—TRAFFIC.		
Total number of passengers	14,714,667	16,926,050
Mean daily number of passengers... ..	40,315	46,373
Mean in % of population	7.07%	7.73%
Trains multiplied by kilometres	3,295,650	3,659,729
III.—LINE AND CARS.		
Length of single track lines in metres	14,944	15,296
Length of double track lines in metres... ..	20,947	22,475
Total length of lines in metres	35,891	37,771
Number of motor cars	94	95
Number of trailers	59	59
IV.—FINANCIAL DATA.		
Share Capital Fcs.	6,000,000	
Gross revenue	1,954,504.24	2,256,671.30
Total outlay (ex-claims damages)	1,018,985.89	1,042,627.37
Costs in % of revenue	52. %	46.5%
Interest on shares	7.66%	11.7%
Directors fees	48,945.34	72,670.03
Balance available for distribution to share-holders... ..	460,000.00	700,000.00
Carried to reserve	26,691.88	40,940.86
Gross revenue per car and kilometre ... Fcs.	0.54	0.56

CAIRO ELECTRICAL SUPPLY.

The business of the Company has during 1902 developped in nearly the same ratio as that observed in the two previous years. As shown on the accompanying statement, the Company has increased their sale of current by 32%, while the number of private consumers has nearly reached the number of 1,200.

Eight kilometres of high and low tension cables were laid under the public roadways. Government control was exercised to safeguard the rights of other companies and the public in as far as they were affected by the existence of these lines.

An arrangement was made with the Company to supply high tension current for driving the two 25 HP. centrifugal pumps, erected for the purpose of discharging the Cairo rain drainage water. The current is

supplied at 2,000 volts and transformed down to 100 volts in our own static transformers.

The pumps are driven by belts from the asynchronous single phase motors which can develop a maximum power of 32 HP each.

In order to permit Government to arrive at a correct valuation of the capital cost of the Company's installation, such valuation being required to serve as a basis in the negotiations for ultimate repurchase, a Committee was appointed to examine into their accounts.

The task was long and tedious, 495 detailed invoices having to be examined and checked.

The Company's accounts were finally passed as correct.

CAIRO ELECTRIC LIGHT STATISTICS.

	PERIOD ENDING 30TH JUNE.	
	1900-1901.	1901-1902.
I.—GENERAL.		
Number of units sold	346,996	458,253
Increase compared with previous year... ..	14.4%	24.8%
10 c.p. lamps connected	43,237	54,152
Increase	10.7%	25.3%
Units per 10 c. p. lamp connected	8.04	8.38
Are lamps connected	82	79
Energy supplied to motors HP.	16½	22
Length of new underground cables metres	10837	7871
Number of consumers	896	1180
II.—FINANCIAL.		
Total revenue Fcs.	347,267.01	458,144.42
Working expenses (see note)	283,764.38	256,172.01
Miscellaneous (frais généraux)	14,975.00	16,100.00
Total expenditure	298,739.38	272,272.01
Capital... ..	2,500,000	
Working profit	48,527.63	185,872.41
Working profit in % of capital	1.94%	7.43%
Carried to sinking fund	1.94%	3.33%
Net interests	—	4.1%
Cost of unit sold	0.852	0.594
Price of unit	1.00	1.00

NOTE.—The high figure of the year 1900-1901 includes compensation amounting to 40,000 frs. paid to an injured workman.

ALEXANDRIA TRAMWAYS.

Mr. Jacot inspected this installation on several occasions: in February for the purpose of ascertaining whether the overhead system was in proper condition, and again in May as a member of the "commission de reception."

The material, especially that employed for overhead construction, is inferior to that used in Cairo. Improvements have however been introduced during the year. They are being continued.

Although the total length of line is greater, the number of passengers carried was less by 50 % than in Cairo.

Further statistics are attached.

STATISTICS.

	Alexandria.	Cairo.
I.—GENERAL.		
Number of years concession	50	50
Concession expiring in year	1946	1946
II.—TRAFFIC.		
Number of passengers in 1902	8,950,000	16,926,050
Length of single track line in metres	13,820	15,296
Length of double track line in metres	33,428	22,475
Total length of line	47,248	37,771
Number of motor cars on December 31st	50	95
Number of trailers on December 31st	50	59
C.—PLANT.		
Maximum capacity in kilowats	1,220	800

ALEXANDRIA ELECTRICAL SUPPLY.

Electricity is supplied by the same Company as in Cairo, but as the authorization was given by the Municipality, the Ministry of Public Works has had no direct control over the installation. It was only after two serious accidents had occurred in 1901 that the Ministry of

Interior asked the Public Works to send an expert to Alexandria to make a report on the state of the overhead wires throughout the town. No attention was paid to this report by the Municipality. In November last another fatal accident occurred, two persons being electrocuted through contact with a broken high tension wire. A large proportion of these wires are still overhead.

A second report was then made by the Public Works electrical engineer and a strong recommendation was made by the Under Secretary of State, Public Works Department, urging on the Municipality the pressing necessity of introducing proper safeguards.

Satisfactory results can however only be attained by the Municipality forcing the different Companies to submit plans for approval, before erecting any installation in the public thoroughfares.

The Contract between the Municipality and the Company is very carelessly drawn up and was not submitted to any proper technical authority.

ELECTRIC LIGHTING IN PROVINCIAL TOWNS.

Mansourah.

Electric light was introduced in 1899, 300 16 c.p. lamps being installed for street lighting.

It is satisfactory to note that this figure has now increased to 430, while an equivalent of 3,500 10 c.p. private lamps is connected to the Company's mains.

In 1902 the Company sold 37,600 units to 96 private consumers; the maximum capacity of the plant being 113 kilowatts.

The current is continuous, generated at 460 volts and distributed at 220 volts on the three-wire system by overhead wires throughout the town.

Ghiza.

A cahier des charges for authorising the distribution of electric energy at Ghiza and Ghezireh has been drafted and submitted to the Contentieux; it is now ready for adjudication.

Ismailia.

The Suez Canal Company asked the Government to authorize a private Company to erect an electrical plant for the distribution of

current to private consumers and further to provide for the street lighting at their (the Canal Co's) cost. The cahier des charges has been prepared and was recently signed by the contracting parties.

Damanhour.

In January 1902 the Ministry of Public Works asked for tenders for lighting the streets by electricity and for the supply of electric energy. Only one tender was submitted which was, too disadvantageous for acceptance.

Suez.

On June the 6th 1902 a concession was granted to Messrs. G. Beyts & Co. for the installation of electric plant and distributing mains at Suez, comprising the erection and maintenance of 200 electric street lamps of 25 c.p. each. The concession is for 20 years; Government has the option on the completion of this term either to purchase the installation, to renew the concession, or to have all wires and accessories removed from the public streets.

In December the definite project was submitted and approved.

The current will be three-phase alternating with a station pressure of 250 volts per phase.

Helouan.

The concession for public and private lighting was given to Messrs. Cook & Son in December 1901 for a period of 20 years. The concessionnaires bought up an existing private installation which had served for lighting several hotels, and have extended the maximum capacity to 100 kilowatts.

The public street lighting is effected by 400 lamps, fixed in pairs of one 10 c.p. and one 16 c.p. on iron brackets projecting from iron poles.

The regular service was started on December 15th.

The current is continuous with a supply pressure of 200 volts.

The following less important installations have been designed by Mr. Jacot's Service and carried out under his supervision:—

Cairo Post Office.—230 incandescent lamps installed.

Lunatic Asylum Abbassieh.—Installation of a continuous current dynamo driven by a 15 HP oil engine, a storage battery and 300 incandescent lamps.

Photographic Ateliers of Survey Department.—Installation of a 24 HP. vertical steam engine driving a continuous current shunt wound dynamo necessary for feeding 4 arc and sundry incandescent lamps.

New Court of Justice.—22 electric fans and accessories installed.

New Egyptian Museum.—Electric fire alarms with 15 contact boxes, lighting conductors, telephones between different offices, 20 electric fans, 68 incandescent lamps.

The electric light installations of the Abdeen Palace and the Khedivial Opera House were, as in previous years, supervised by this Service in so far as danger of fire is concerned. In the Opera House a large proportion of the wires are fixed to very dry and unpainted timber. Other wires are hidden and quite inaccessible. Frequent inspection of the safety appliances is therefore indispensable. Testing of the insulation is also undertaken at the beginning of each season.

The Daira Khassa submit their accounts referring to electrical matters to this Service for examination; installations at Alexandria necessitate an inspection on the spot.

NEW REGULATIONS.

A code of regulations applying to electric installations in general is urgently required. This applies specially to Alexandria, where the Municipal authorities have no electrical expert at their disposal and where the technical clauses of the various concessions were not studied with sufficient care when contracts were drawn up.

In order to meet this want a set of rules has now been drawn up by Mr. Jacot comprising provision for the regulation of:

- a. The installation and maintenance of high and low tension plants.
- b. Electrical conductors whether erected in parallel lines or crossing each other or traversing railways lines.
- c. Installations and maintenance of electric railways.

These regulations are based on the latest European models in England, Germany and Switzerland. They have been adopted by Mr. Jacot to meet local requirements.

HELWAN WATER WORKS.

Expenditures.

£ E.
2,122

Receipts.

	£ E.
From private persons	2,230
Government Account	1,396
Total... ..	<u>£ E. 3,626</u>

1,503 Gross Profit.

3,625

Detail Government Account :

	C.M.
Local Commission	75·048
Baths Hotel..	18·375
Tanzim Gardens (open to the Public) and Police...	9·330
Square in front of Railway Station... ..	7·424
Station Garden	1·462
Total... ..	<u>£ E. 111·639</u>

GHIZEH AND GHEZIREH WATER SERVICE.

Expenditures.

£ E.
4,500

Receipts.

	£ E.
Supply of water on Government Account... ..	5,588
H.H. Prince Hussein and H.H. the Princess Fatma Hanem..	662
Private supply by water meter	930
Ghizeh town supply	188
Total... ..	<u>£ E. 7,368</u>

2,868 Gross Profit.

7,368

For a number of years this Service has been asking for a grant of £E.2,000 to lay on water for the town of Ghizeh. In 1901 £E.500 was granted as a trial.

The result of this trial is gratifying. Against an expenditure of £E.500, the receipts were £E.188, and notwithstanding the low price charged for the water, 60% of the receipts represent clear profit.

GHIZEH NURSERY.

The work in the Nursery has been very satisfactory, it having been found possible to execute all orders received for trees, shrubs and flowers.

The Nursery is now in a position to supply every year at least three times the quantity supplied in 1902, and this with very little increase in the yearly expenditure.

Hardly any demands for trees, etc., were received from the different Local Commissions, doubtless owing to their very limited budgets not admitting expenditure on this head. We shall be able in 1903 to supply a number of trees gratis. The existing number of lebakh trees and their ages are given in the following statement A.

The best ages for transplanting is from eight to twelve years.

		Age.	Number.
Lebakh trees in stock.	A	9 years	40
		8 "	52
		7 "	115
		6 "	539
		5 "	1020
		4 "	3987
		3 "	5290
		2 "	4810
		1 "	22673
	Total		38524

STATEMENT OF RECEIPTS AND EXPENDITURE FOR THE GHIZEH NURSERY, 1902.

TREES, SHRUBS AND FLOWERS, SUPPLIED TO GOVERNMENT GARDENS, CAIRO.

Ezbekieh Garden.

Shrubs and trees...	326
Flowers in pots ...	17048

Cairo City Tanzim.

Shrubs and trees...	510	The total represents a sum of:
Flowers in pots ...	18311	
		£E. M.
		499 620

Survey Department.

Trees ...	55
Flowers in pots ...	2271

Section No. 4.

Trees...	164	
Sale of flowers to private persons	59	045
Sale of 2,469 trees	247	316
Total...	£E.805	981

EXPENSES :

*Salaries...	454	645
Poles for trees, rope and other stores	143	392
Total...	£E.598	037

TREES IN SECTION N° 4.

Ghezireh Promenade.

In section N° 4 there are in all about 4,800 Lebakhs. This represents a length of road of 24,000 metres; the new Ghezireh Promenade 1,200 metres in length is planted with palms. This makes a total length of road of 25,200 metres. Owing to the great length it is almost impossible to have efficient control over the men and watering carts. The expense in consequence is heavy. 164 young Lebach trees were planted this year.

EXPENSES.

	£E.
Salaries of one reis and workmen	159,170
Watering and other carts	206,665
Making 161 iron tree guards in Ghizeh workshop	69,223
	<u>435,058</u>
Sale of timber and branches of trees	134,000
Total expenses	<u>£E.301,058</u>

* Under the item of salaries is included the pay of one Clerk and one Reis.

ESBEKIEH GARDENS.

The gate receipts for the year were £E.1,183.593 or £E.28.749 in excess of the receipts in 1901. Both the English and native bands were stopped on the outbreak of cholera. If this had not been the case there would have been a considerable increase of gate money over former years.

£E.381.250 was paid out of the gate receipts for salaries to collectors, cloak room attendants, garden rangers and the English Military band; the remainder is placed to the credit of the service.

A further length of iron railing was erected in 1902 from the grotto running in front of the Fencing Club up to the South gate.

	£E.	MIL.
RECEIPTS FROM GATES	1,183	593

EXPENSES:

	£E.	MIL.
Salaries, Clerks and Garden Rangers	300	000
English Military Band	81	250
Total	<u>£E.381</u>	<u>250</u>

ESBEKIEH GARDEN EXPENSES FOR 1902:

Gas	361	892
Water	689	310
Salaries, Gaffirs	190	850
Uniforms for Gaffirs	13	350
Sewage Company for clearing cesspools	20	585
Iron railings	111	609
Mule for pump	10	906
Native Military Band	194	977
Salaries, Workmen	342	380
Staff, included Boabs, Clerk and Reis	267	772
Stores, seeds, hoses, telephone, carts, carting new earth, sand, etc.	250	587
Total	<u>£E.2,454</u>	<u>218</u>

RECAPITULATION.

	£E.	MIL.		£E.	MIL.
RECEIPTS... ..	1,183	593	EXPENSES... ..	2,454	218

COMPARATIVE STATEMENT OF THE RECEIPTS OF THE ESBEKIRH GARDENS
FROM 1897 TO END OF OCTOBER 1902.

MONTHS.	1897	1898	1899	1900	1901	1902
	£E.	£E.	£E.	£E.	£E.	£E.
January	17.590	70.626	56.698	67.394	61.401	72.733
February	21.610	129.308	116.989	88.736	131.716	134.634
March	26.440	95.486	77.876	117.212	91.968	134.362
April	28.970	98.839	102.184	137.449	121.699	123.176
May	31.290	137.800	176.018	167.219	153.251	152.064
June	42.190	152.171	153.638	170.465	152.943	146.747
1st Half-Year ...	168.090	684.230	683.403	748.475	712.978	763.725
July	34.635	142.391	131.260	124.427	132.391	130.833
August	27.185	105.086	128.134	110.221	74.501	67.586
September	18.755	112.995	123.328	119.057	67.200	54.288
October	18.305	79.971	97.381	81.666	51.991	52.865
November	16.705	70.105	68.893	76.298	56.250	58.380
December	24.200	60.172	61.488	61.936	58.292	54.916
2nd Half-year ...	139.785	570.720	610.484	573.605	440.625	418.868
Total... ..	307.875	1,255.050	1,293.887	1,322.080	1,153.603	1,182.593

RAPPORT

SUR LES

TRAVAUX DE PRÉSERVATION DES CATACOMBES

A KOM-EL-CHOUGAFA. ALEXANDRIE

PAR

M. EHRLICH,

INSPECTEUR DES BATIMENTS DE L'OUEST.

RAPPORT

sur les

TRAVAUX DE PRÉSERVATION DES CATACOMBES

A KOM-EL-CHOUGAFA

Le Président du Comité du Musée Gréco-Romain à Alexandrie, Hassan pacha Mohsen, a signalé, dans sa lettre ci-jointe, le danger qui, selon lui, menace le monument des catacombes, à Kom-el-Chougafa.

Ce danger proviendrait de différentes causes que voici en détail :

- 1° Des infiltrations considérables qui menaceraient la base des parois.
- 2° Du poids énorme des strata de terres sur le rocher.
- 3° De l'état des voûtes et architraves des salles et corridors dangereusement fissurés.

Après un examen très minutieux du monument, je dois dire que le danger menaçant ses différentes parties ne me paraît pas aussi grave qu'il paraît ressortir du rapport fait par S.E. Mohsen pacha.

Examinons maintenant les travaux qu'il propose d'exécuter en vue de sauver le monument.

Ces travaux peuvent être rangés sous quatre catégories différentes. Il propose :

1° *Consolidation des parois* sur toute leur étendue pour leur donner l'assiette nécessaire et en prévenir l'écroulement.

2° *Déblaiement des couches extérieures* pour alléger la pression sur les voûtes et corridors à l'intérieur.

3° *Consolidation des voûtes elles-mêmes.*

4° *Épuisement des eaux d'infiltration.*

Le montant de ces travaux a été estimé sommairement par les ingénieurs de la Municipalité à L.E. 2000. Un devis détaillé n'existe pas.

Ad. 1. — La consolidation des parois en vue de prévenir leur écoulement ne me semble point nécessaire. La crainte d'un accident pareil existerait seulement au cas où de grands creux se seraient produits dans le sous-sol et que les murs cèderaient à l'action combinée du poids supérieur et de l'effet des infiltrations souterraines tâchant de produire des affouillements dangereux. Le poids, on peut l'alléger, nous le savons déjà, et la présence continuelle des infiltrations tout à fait stables, non sujettes à des hausses et baisses et tendant à remplir ces creux, s'il en existe, me semble au contraire exercer une espèce de contre-poids ou contre pression qui agirait en sens opposé à la pression travaillant par en haut.

Ad. 2. — Le déblaiement des monticules de décombres qui coiffent le noyau rocheux renfermant le monument, constitue une mesure de précaution très nécessaire à prendre pour alléger le poids et réduire le danger d'un affaissement soudain des architraves et voûtes taillées dans ce même rocher, quoique ceci, comme je le dis au prochain paragraphe, ne me paraît pas très probable.

Ce travail est compris dans l'estimation jointe à ce rapport.

Ad. 3. — La consolidation des voûtes elles-mêmes ne s'impose pas comme une nécessité. On a beau examiner les plafonds partout, dans les hypogées, dans le temple, ou dans les corridors de dégagement des « *loculus* », on ne peut y découvrir aucune fissure. Non seulement, mais les portées qui en largeur n'excèdent nulle part 2^m,50 entre les parois et se tiennent souvent en dessous, ne me paraissent pas suffisamment grandes pour donner lieu à des craintes d'un écoulement, surtout après le déblaiement des couches des décombres au-dessus.

Tout ce qu'on voit sur les faces des voûtes et des parois, sont des cavités plus ou moins profondes, qui se sont produites dans le rocher par l'influence des agents atmosphériques, et lui donnent l'apparence et les qualités extérieures du « *tuf* ». Néanmoins la pierre est dure et paraît d'une densité suffisante pour exercer la résistance voulue.

Salle
Caracalla.

Il y a un endroit, cependant, vraiment menacé et qui demande une attention tout à fait spéciale et immédiate. C'est le grand mausolée attribué à l'empereur Caracalla. C'est une immense salle formant l'extrémité Est de l'ensemble des salles et chambres dans la galerie supérieure, c'est-à-dire la première qu'on rencontre en descendant par l'escalier tournant.

Ici une grande partie du plafond s'est écroulée l'année passée, et la masse énorme de débris, qui remplit la salle sur $\frac{2}{3}$ de sa hauteur, fait témoignage de l'importance de l'accident.

Ayant trouvé les parois dans un état de détérioration très avancé, et leurs bases même dégradées jusqu'à ce point qu'on y voit des grands creux mesurant jusqu'à 1 mètre de profondeur, je considère qu'il serait très dangereux d'engager ces parois dans les travaux de consolidation du plafond, quel que soit le système adopté pour un tel renforcement.

Travaux
de
consolidation

Je propose donc de construire une série de piliers en briques à distance à peu près égales le long des parois, et d'y appuyer des arceaux en briques prenant leur naissance dans les pieds-droits. Ces arceaux recevraient une maçonnerie également en ciment composée de moellons du Mex, montant jusqu'au plafond actuel et remplissant bien tous les creux et inégalités de la surface.

De cette façon je crois que le plafond sera parfaitement garanti contre tout danger à l'avenir.

Comme *travail supplémentaire* à ceux indiqués ci-haut, je proposerais encore de construire une murette en briques comme couronnement au mur de la périphérie du grand puits circulaire, qui donne appui à l'escalier tournant descendant dans les catacombes. Elle aura pour but d'empêcher les eaux pluviales, qui descendent souvent en vrais torrents du haut des collines, d'entrer dans le temple.

Ad. 4. — Les tableaux n^{os} 1 et 2 (voir pages 340 et 341), pourront illustrer le résultat des épuisements et les différentes phases par lesquelles ils ont passé jusqu'à la suspension des travaux en date du 30 juin.

Ici un bref récit des travaux entrepris pour arriver au moyen d'épuisements à baisser les eaux dans le temple et à nous renseigner sur leur nature, leur force et leur provenance.

Les travaux préliminaires ont commencé le 25 mars.

Ayant un crédit très modeste à ma disposition, j'ai d'abord essayé d'arriver à un résultat si petit qu'il soit, en installant deux pompes de la Municipalité, qui sont sous la charge de la Brigade des Pompiers, et que M. le Commandant de la Police a bien voulu me prêter à titre gracieux.

Pompes
de la
Municipalité.

Les difficultés qui s'opposaient à ce travail étaient énormes. Comme la Municipalité ne pouvait pas me permettre de lancer les eaux de refoulement dans leurs égouts à côté, il a fallu les amener vers le canal Mahmoudieh, jusqu'à presque 300 mètres de distance, et ceci en passant sur un terrain des plus accidentés. Des arrêts continuels et des réparations fréquentes aux pompes en étaient la suite ; et vers la fin du mois d'avril, j'ai dû renoncer à l'emploi de ces pompes.

Puits creusé
à l'extrémité
Nord
du Temple
(voir plan n° 7)

La hauteur excessive du refoulement dont on peut se rendre compte en étudiant les altitudes portées sur les plans et coupes, présentait de grandes difficultés techniques. J'ai bientôt vu que, pour réduire cette hauteur autant que possible, le point indiqué était l'extrémité nord, point « M » du plan d'ensemble. C'était l'endroit de l'ancienne entrée dans le temple, qui était encore accessible en 1901 et fut bouchée ensuite par M. le D^r Botti, conservateur du Musée, par un arceau en briques, sur lesquelles il posait des remblais jusqu'au niveau de la route d'accès venant de la ville.

Ici on se trouvait au pied des collines et on gagnait environ 7 mètres en hauteur pour la sortie des eaux de refoulement.

A l'aide de sondages, qui furent précédés d'un relevé exact du temple et des collines qui le coiffent nous sommes arrivés à fixer sur le terrain de la surface exactement l'endroit où devait se trouver l'ancienne ouverture. Aussitôt ce point établi, un nouveau puits fut creusé, mesurant 4 mètres x 4 mètres de côté, sur 8 mètres de profondeur, avec ses flancs supportés par un boisage en madriers de fortes dimensions formant palplancher. L'arceau en briques fut coupé pour le passage des tuyaux, et, après un travail de presque un mois, on était prêt de procéder avec une nouvelle installation de pompes plus puissantes et nous permettant de travailler sous des conditions techniques plus satisfaisantes.

Le crédit primitif de L.E. 300 étant presque épuisé, un crédit supplémentaire de L.E. 300 nous fut ouvert, sur ma demande, par le Ministère des Finances.

On procéda ensuite avec l'installation de deux pompes centrifuges fournies par l'Entreprise Almagià.

Pompes
centrifuges.

Une seule pompe ne pouvant suffire, on a installé deux centrifuges de 20 centimètres de diamètre, dont une, fabrique Dumont, et une, Schlieck, donnant un débit moyen de 275 mètres cubes par heure.

En s'écartant du système usuel qu'on suit dans un cas pareil, et qui consiste à rendre la pompe inférieure indépendante de celle en haut en la faisant jeter les eaux de refoulement dans un réservoir spécial, dans lequel puise le tuyau d'aspiration de la pompe supérieure, on a accouplé les deux pompes par un tuyautage continu. Ce système a beaucoup simplifié le travail, étant donné l'espace très restreint à notre disposition dans ce puits si étroit.

Deux locomobiles ont été installées en haut, une faisant marcher la pompe supérieure, l'autre, par une transmission assez compliquée et difficile à établir, celle d'en bas.

Après beaucoup de tâtonnements et d'essais sans résultat, dictés par le désir d'économiser de l'argent, nous sommes arrivés à voir que la seule solution promettant un succès, quelque petit qu'il soit, était d'établir une *communication directe* entre l'escalier du centre conduisant aux galeries inférieures, où l'eau affluait avec le plus de force, et le vieux canal creusé par les architectes dans l'antiquité. Je parle du canal qui enveloppe les parois postérieures du temple proprement dit, du côté nord, est et ouest.

Pour obtenir cette communication, on a fait une entaille dans les marches de l'escalier central, travail que M. Botti, consulté au préalable, a bien voulu autoriser.

Une fois cette communication établie, les pompes étaient nourries abondamment, et leur fonctionnement était assuré.

Le résultat était :

La découverte du sol de la galerie centrale, jusqu'à présent inaccessible, à la cote - 0.97, c'est-à-dire à 2^m,50 au-dessous du radier du temple.

Ainsi nos longs travaux furent enfin couronnés de succès, et le but atteint, qui était de savoir si par épuisements on pouvait arriver, au moins temporairement, à baisser les eaux à l'intérieur des catacombes jusqu'au fond de la plus basse galerie comme jusqu'à présent.

Les tableaux suivants, pages 340 et 341, donnent le résultat des épuisements pendant les mois d'avril, mai et juin.

TABLEAU N° 1

DONNANT LES COTES DU CANAL ET DU TEMPLE

MAHMOUDIER CANAL			TEMPLE		DIFFÉRENCE niveau B et A	OBSERVATIONS
Semaine terminant le	A.	B.	a.	b.		
	Moyenne par semaine.	Moyenne par époque.	Moyenne par semaine.	Moyenne par époque.		
	M.		M.			
Mars 31	+1.97		+1.56			
Avril 7	1.93	+1.87	1.56	+1.56	0.31	Pompé 2 jours. } 1 ^{re} Époque.
" 14	1.81		1.53			
" 21	1.78		1.57			
" 30	1.84		1.47			
Mai 5	1.76		1.45			Pompé 2 jours.
" 12	1.85		1.44			
" 19	1.90	+1.86	1.42	+1.43	0.43	Pompé 2 jours. } 2 ^{me} Époque.
" 26	1.91		1.43			" 3 "
Juin 2	1.80		1.42			" 4 "
" 9	1.93		1.39			" 5 "
" 16	1.80		1.34			
" 23	1.78	+1.84	1.34	+1.34	0.48	Pompé toute la semaine avec interruptions. } 3 ^{me} Époque.
" 30	1.87		1.31			
Juillet 6	1.77		1.37			
" 11	1.93		1.36			
" 18	1.77		1.36			
" 25	1.70		1.34			
" 31	1.63		"			
Août 7	1.83		1.29			
" 14	1.83	+1.81	1.29	+1.30	0.51	} 4 ^{me} Époque.
" 21	1.84		1.28			
" 28	1.75		1.30			
Septembre 4	1.85		1.28			
" 11	1.77		1.30			
" 18	1.91		1.30			
" 25	1.88		1.31			

Note. — Les cotes sont toutes réduites au zéro des Irrigations, soit au niveau des plus basses mers.

TABLEAU N° 2

(Supplément au N° 1).

	A.	B.	C.
	R.L. Eaux Canal Mehmedieh	R.L. Eaux dans le Temple.	R.L. Epuiséments
	M.	M.	M.
1 ^{re} époque, du 25 mars au 21 avril, avant de pomper sérieusement.....	+1.87	+1.56	0.31
2 ^{me} époque, du 21 avril au 9 juin. — S'écoule dans des essais plus ou moins satisfaisants de baisser les eaux au moyen des pompes à incendie de la Municipalité d'abord, ensuite des pompes centrifuges installées par l'Entreprise Almagia. La communication directe entre le chenal d'aspiration et le puits principal de l'escalier inférieur du temple n'est pas encore établie.....	+1.86	+1.43	0.43
3 ^{me} époque, du 9 juin au 30 juin. — La communication avec l'escalier est établie par entaille dans le rocher. On pompe avec succès. L'eau est baissée temporairement jusqu'au pied de l'escalier inférieur du temple, soit à la cote -0.97 (hauteur épuisée 2 ^m ,50).....	+1.82	+1.34	0.48
4 ^{me} époque, du 30 juin au 25 septembre. — Les épuisements sont arrêtés et les pompes enlevées.....	+1.81	+1.30	0.51

Note. — La colonne B donne la cote à laquelle le niveau des eaux dans le temple retourne après arrêt temporaire des pompes.

Le niveau du canal est resté à peu près stable. Du reste, il est connu par les renseignements obtenus des irrigations qu'en temps ordinaire la crue du Nil ne se fait pas sentir dans le canal, près d'Alexandrie. Conclusions.

Le niveau dans le temple. — Il y a une diminution incontestable des eaux dans le temple. Elles ont baissé de 0^m,26 depuis le commencement des travaux.

Après la suspension des épuisements, la cote dans le temple est restée stable à la cote moyenne de +1^m,30 depuis presque trois mois, sans aucune tendance de retourner à la hauteur primitive de +1^m,56.

Entrons maintenant dans la question de la provenance des eaux, et voyons si leur présence est vraiment nuisible au monument. Nature et provenance des eaux.

D'où viennent ces eaux?

Peut-on les combattre?

Vaut-il la peine de les combattre?

Au préalable, je désire constater que l'eau telle qu'on la trouve actuellement dans le temple couvrant l'escalier central descendant dans la galerie du sous-sol, n'est pas du tout saumâtre. Elle est limpide et semble posséder toutes les qualités de l'eau d'un puits, bien filtrée par le terrain sablonneux et rocheux qui l'entoure.

Pour moi, il ne peut donc pas s'agir de l'eau de mer, dont la cote moyenne, du reste, n'atteint jamais celle constatée dans le temple.

Histoire du Canal. — Il serait intéressant d'entrer pour un moment sur le terrain historique. Sur l'existence du canal Mahmoudieh, dans l'antiquité, on ne peut plus avoir de doute.

On sait par le témoignage positif de Strabon ⁽¹⁾, qu'en sortant d'Alexandrie par la porte de Canope « porte Est » on avait à sa droite le canal de ce nom qui suivait parallèlement et à peu de distance les bords de la mer.

Quel que soit le cours que le canal ait suivi dans l'antiquité, soit en enveloppant l'extrémité méridionale et occidentale de la ville, tel qu'il existe aujourd'hui, et qu'il se trouve indiqué sur les deux plans de l'ancienne Alexandrie, faits par Néroutsos bey et M. le docteur Botti respectivement, ou bien en *traversant* le centre de la ville, — voir le témoignage de Hirtius, "*De Bello Alexandrino*," Cap. V, cité dans le *Mémoire sur le Canal d'Alexandrie*, élaboré par les membres de l'expédition française de 1799, — il paraît sûr que la nécessité de creuser un canal amenant l'eau potable à la ville d'Alexandrie, s'est fait sentir bientôt après sa fondation, car le système de citernes ne pouvait pas suffire longtemps à une ville qui, vers l'an 300 av. J.-C., était déjà devenue la ville la plus peuplée de l'Égypte.

Comme, d'un autre côté, l'origine des Catacombes de Kom-el-Chougafa est attribuée par les savants à l'époque Augustéenne ou dernière Ptoléméenne, on pourrait, sans trop s'écarter de la vérité, fixer la date de l'origine de ce monument à 200 ans plus tard.

Or, nous nous trouvons vis-à-vis du fait que les catacombes ont été taillées dans le rocher à sec, et ceci en dépit de l'existence du canal d'Alexandrie à une distance très proche des tombeaux.

Si le sous-sol était imbibé avec les infiltrations du canal, les architectes qui dirigeaient les travaux devaient rencontrer ces eaux à peu de profondeur sous la surface du terrain naturel, et auraient renoncé à leur tâche devant un ennemi si puissant.

(1) Strabon, Géogr. liv. XVII.

Du temps des anciens, il n'y avait donc pas d'infiltrations malgré l'existence du canal à côté.

Canal de communication avec le Mahmoudieh. — On a parlé — du reste M. Botri est partisan de cette théorie — d'un chenal de communication qu'on aurait creusé à une époque plus récente que celle de la construction des catacombes, pour amener les eaux dans le temple.

Il est très difficile de voir dans quel but on aurait établi une pareille communication.

En outre, un tel travail présentait des difficultés énormes. On n'a qu'à étudier les cotes y relatives. Le sol du corridor mis à sec par nos épuisements, qui est la plus basse galerie jusqu'à laquelle nous avons pu pousser les travaux, est à la côte $-0^m,97$ réduite au zéro des basses mers. D'après les sondages faits, la surface du rocher se trouve environ à la côte $+14^m,50$ du côté du canal. On devait donc creuser un canal sur 300 mètres de longueur à une profondeur d'environ $15^m,50$ au-dessous du rocher et en montant tout le temps, parce que, d'après le rapport de l'expédition française, le plafond du canal, à une demi-lieue d'Alexandrie, était un peu plus bas que le niveau de la surface de la mer pour aller en contre-pente, c'est-à-dire en montant, vers l'ancienne enceinte des Arabes, qui passait tout près des catacombes.

Le chenal de communication, s'il existait, devait donc monter également vers le canal Mahmoudieh.

Mais cette théorie est définitivement contrariée par le fait que l'eau dans le temple devrait se niveler exactement avec le canal, si vraiment cette communication, soit directe soit indirecte, existait.

Ceci, nous le savons de ce qui précède, n'est pas le cas.

RÉSUMÉ

D'après ce que nous avons démontré ci-haut, il est donc difficile de croire à des infiltrations provenant du canal. Car elles n'existaient pas dans l'antiquité, ou, du moins, elles ne se faisaient pas sentir; en outre, la relation des altitudes entre le canal et le temple respectivement, n'a pas changé depuis l'ouverture des catacombes, et le tableau des niveaux, joint à ce rapport, fait voir une diminution sensible des eaux après les épuisements sans aucune tendance de remonter à l'ancienne hauteur dans une période de trois mois après la suspension des travaux.

On ne peut croire davantage :

A une communication directe avec le canal pour les raisons données ci-haut.

La vraie solution du problème me paraît être donnée par la supposition que nous avons à faire à une nappe d'eau très étendue, formant un grand réservoir à travers les cavités du rocher et provenant de deux causes.

1. — DE L'AFFAISSEMENT GÉNÉRAL DE LA PLAGE.

D'après les chroniqueurs arabes de l'époque (¹), en l'an 702 de l'hégire, 1324 de notre ère, un violent tremblement de terre visita la côte de l'Égypte, et causa un affaissement général de la plage. L'existence des vieilles fondations des anciens palais au fond de la mer en fait preuve. La trace de ces fondations fut découverte partout pendant la construction du nouveau quai.

Aujourd'hui cet affaissement est un fait admis par tous nos savants.

Cette commotion a dû se répandre sur toute la ville et a dû comprendre dans son rayon le canal et les catacombes, qui, en se baissant, devaient entrer dans la zone de l'eau souterraine qui a rempli les galeries inférieures du monument.

2. — DES EAUX DE SUPERFICIE PROVENANT DES PLUIES.

Les pluies qui se sont abattues pendant 2000 ans sur ces collines, rencontrant un terrain très perméable, et, où il était rocheux, formé par une pierre fort absorbante, ont fini par s'accumuler et hausser la côte des eaux à l'intérieur des catacombes, sans aucune chance d'une évaporation.

Eaux des puits et sakiehs dans le voisinage. — Pour terminer mes recherches, j'ai mesuré aussi les puits dans le voisinage des catacombes du côté du canal Mahmoudieh. Ces puits, au nombre de trois, sont situés à mi-distance environ entre les collines et le canal.

J'ai constaté les côtes suivantes, prises le 24 juin, c'est-à-dire vers la fin des épuisements :

	Côtes de l'an.
a) Ancienne Sakieh de la Compagnie du Gaz (abandonnée)...	+ 1 ^m ,35
b) Sakieh dans un jardin à 100 mètres du canal	+ 0 ^m ,64
c) Puits près d'un four à chaux à 150 mètres du canal	+ 1 ^m ,23

— Ce nivellement a été fait deux fois, *a* et *c* se rapprochent beaucoup de la côte moyenne de cette époque dans le temple, soit 1^m,34, *b* reste beaucoup en dessous, chose qui paraît étrange au premier coup d'œil.

(¹) NÉROUTSOS BEY, *Étude sur l'Ancienne Alexandrie*, Chap. IV, p. 20.

Mais il est un fait connu que la densité des couches de terre dans le sous-sol change quelquefois rapidement d'un point à l'autre et l'eau doit suivre toujours la ligne de la moindre résistance.

Si on regarde l'ensemble des côtes ci-dessus, qui sont beaucoup plus basses que la côte moyenne du canal, je crois pourtant que nous avons une autre preuve ici, que c'est *l'eau souterraine* qu'on a trouvée et non des infiltrations du canal Mahmoudieh.

D'après ce qui précède, il est simple de répondre aux deux autres questions posées à la page 342.

Nous savons maintenant :

1° Que *temporairement* et à l'aide de pompes puissantes, on peut les baisser tant qu'on veut.

Possibilité
de combattre
les eaux.

2° Que *d'une façon permanente*, l'eau se trouve réduite à une côte 0^m,26 plus basse que la côte primitive.

3° Qu'on pourra peut-être réduire cette côte encore plus. Mais je n'y vois aucune utilité tant qu'on n'arrive pas à enlever les eaux définitivement et à tout jamais.

4° Que ceci paraît impossible, car, à chaque arrêt de pompes, l'eau affluait avec force de tous les côtés et même le bouchage au ciment des sources souterraines n'a pas pu arrêter l'affluence des eaux.

Les frais des nouveaux épuisements, si on voudra les reprendre à une date future, sont calculés sommairement et à part dans l'estimation jointe à ce rapport.

Ces épuisements ne pourraient avoir que deux buts à atteindre :

Utilité des
épuisements
à l'avenir.

1° La consolidation du monument.

2° La continuation des recherches archéologiques.

J'ai déjà exposé mes vues sur le premier point et je répète qu'il me semble même risqué de déranger les eaux dans le sous-sol. Cette grande nappe d'eau, toujours stable, forme une espèce de radier général, et, par ce fait, une bonne base pour les parois, qu'il serait dangereux d'enlever soudainement.

Quant à l'utilité de continuer les recherches archéologiques, j'avoue mon incompetence.

Mais je doute qu'on réussira jamais de pousser ces recherches plus en avant, en présence des difficultés techniques que j'ai tâché de décrire dans ce rapport.

DEVIS

POUR LES TRAVAUX DE CONSOLIDATION DES CATACOMBES DE KOM RI CHONGAFA

			L.E. MIL	L.E. MIL
	m ³	Déblai des collines.		
1 ^{re}	10.000	<i>Déblai de terres</i>	0.040	400. —
	m ³	Salle Carascalla.		
2 ^{re}	50	<i>Déblai de terres</i>	0.060	3. —
	m ³	Renforcement plafond.		
3 ^{re}	10	<i>Fondation des piliers. — Bêton composé de deux parties de caillasse et une partie de mortier. Le mortier sera composé de deux parties de sable et une partie de ciment Portland</i>	1.200	12. —
4 ^{re}	36	<i>Élévation. — Maçonnerie de briques Bircher hourdées au mortier de ciment Portland comme à l'art. 3</i>	2.—	72. —
5 ^{re}	6	<i>Maçonnerie de briques comme à l'article précédent pour voûtains</i>	3.—	18. —
6 ^{re}	400	<i>Fer rond pour tirants de chaînage et plaques en fer de 0.50 x 0.50 x 0.015</i>	0.035	14. —
7 ^{re}	20	<i>Maçonnerie pour remplissage en moellons hourdés au mortier de ciment Portland comme à l'art. 3.</i>	1.00	24. —
	m ³	Murette de couronnement sur puits principal.		
8 ^{re}	40	<i>Maçonnerie de briques du pays hourdées au mortier de ciment Portland comme à l'art. 3</i>	1.340	53.600
9 ^{re}	154	<i>Caniveau pour drainage des eaux pluviales</i>	0.100	15.400
10 ^{re}	325	<i>Enduit de 2 centimètres d'épaisseur au mortier de ciment Portland pour recouvrement maçonnerie du dit mur</i>	0.095	30.875
		Total	L.E.	642.875
		Imprévu	*	107.125
		Montant général...	L.E.	750.—

Note. — Suivent les renseignements pour frais d'épuisement.

A part les frais d'installation, ammortissement du matériel, bénéfice d'industrie, intérêts du capital, etc., on peut fixer comme suit le prix de revient des épuisements exécutés à une profondeur variable entre 5 et 9 mètres par une pompe centrifuge (Dumont) de 18 à 20 c. m. de diamètre, actionnée par une locomobile ordinaire de la force de 12—16 H. P.

Analyse pour une journée de 10 — 12 heures de travail.

Charbon kg. 500 à frs. 40 par tonne	...	...	...	Frs. 20.—
Mécanicien, chauffeur, etc.	...	...	...	» 6.—
Manœuvre pour transport d'eau, etc.	...	...	...	» 2.50
Huile, graisse, courroies, etc.	...	...	...	» 5.—
Réparation, imprévu, etc.	...	...	...	» 3.50
Total...	...	...	...	Frs. 37.—

Pour une installation comme celle faite à Kom-el-Chougafa, c'est-à-dire avec 2 pompes accouplées et tuyautage continu il y a lieu certainement à une augmentation des frais d'au moins 25 % à cause du plus grand effort demandé aux locomobiles, à la spéciale surveillance, etc. Par contre, une installation définitive qui permet d'employer des moyens perfectionnés et fixes, peut donner une économie d'au moins 40 % dans la consommation du charbon.

Pour frais d'installation des pompes même avec locomobiles, on peut ajouter une fois pour toutes une somme de L.F. 250.

REPORT ON THE SURVEY DEPARTMENT

For 1902

BY

CAPT. H. G. LYONS,

DIRECTOR-GENERAL, SURVEY DEPARTMENT.

SURVEY DEPARTMENT REPORT, 1902.

During the year 1902 the methods of survey employed were generally the same as those described in the annual report for 1901, but certain improvements have been made and the various data are of more value and more exact since they are now deduced from a longer series of observations. It has been necessary to work at very high pressure, much higher than is good for the work turned out, in order to complete the provinces of Menufia and Fayum in time for the Reassessment Commissions. Work was carried on in Taftishes for as much as 14 hours per diem in the months of June and July, and the final checking was in some cases hurried and insufficient. The cause of the delay which produced this congestion of the work was explained in last year's Report, and the same removal of survey marks went on uninterruptedly until the end of the work. In the provinces of Qaliubia and Daqahlia very few have been removed, and consequently the work is in a forward state.

There has been a steady improvement in the class of work turned out and a small decrease in the cost, but so long as work is carried on under the existing conditions it seems improbable that the latter can be reduced.

As there is no authority to oblige landowners to be present at the time of survey, the information of the Omda and Sheikhs has to be taken in the case of absentee owners; this is often wrong and causes considerable expense and delay to correct it later.

The high rate of work which is necessary also tends to increase the cost. The data furnished by the old land registers are very insufficient, and it is necessary to refer to the village Omda for further information. In some cases inaccurate information is intentionally given, causing considerable hardship to small proprietors, but it is practically impossible to get reliable evidence to prove it. The only safeguard is the frequent inspection of the work *in the village* by the Inspector. However as higher accuracy is aimed at, and as the checking and examination of the Registers is more minute and the verification of areas is more thorough, it becomes increasingly difficult for an Inspector to see the work in the village as often as he would like to do. The

average work of an Inspector and the amount of inspection he has been able to do is shown in the following table :—

Average number of Villages.	Average number of surveyors and computers.	Average number of visits per Village.
54.3	35	2.0

It would be a distinct improvement to reduce the number of surveyors in the 6 Taftishes now working and to form another Taftish, in order to obtain increased inspection.

The maps this year show a very great increase in topographical accuracy, which is partly due to the improved theodolite traverse work. The boundaries of plots cannot be so certainly accurate; there is no obligation on proprietors to mark the limits of their properties in a permanent manner, so that, even though the map at the time of survey may be perfectly accurate, the boundary line soon becomes slightly changed in position as the last furrow in ploughing is more or less straight, and this in long and narrow plots may easily make a difference in the area.

It is greatly to be desired that the maps after being sent to the Mudiria for custody should be corrected and brought up to date by trained surveyors. At present they are either not corrected or are corrected by men who are, as surveyors, inferior in technical skill to those who originally produced them. The result is that the maps rapidly go out of date and become to a great extent obsolete.

A special advance has been made during the year in the publication of topographical maps on the scale of 1/10,000. As was stated in the report for 1901, the field work of revising the old survey of 1892 was commenced in August 1901, and by the end of the year 34 sheets had been completed; several of these had been drawn and partly printed but none had been actually published by the end of the year. During 1902 this work has been actively prosecuted and by the end of the year a total of 112 sheets of 24 square kilometres each had been revised, making with what was done in 1901, 146 sheets. Of these 118 were printed and published during the year, as well as 6 of Gharbia, making 124 sheets in all.

Methods have been gradually simplified and systematised during the year, so that a year's out-turn calculated at the rate of production of the last 3 months may be taken as 150 sheets. This number of sheets

each including an area of 21 square kilometres * gives a total published area of about 3,000 square kilometres per annum, which approximately equals that surveyed annually by the Revenue Section of the Survey.

At present, large scale (1/4000 and 1/2500) maps exist for the whole of the Delta and Giza and Fayum Provinces, and for some of these there are original maps on a scale of 1/10,000 surveyed from 6 to 10 years ago but never published. Some 1,500 square kilometres of the total of 16,000 square kilometres have already been revised to date and printed, leaving 14,500 square kilometres to be dealt with. Besides this there is an annual out-turn of about 3,000 square kilometres by the Revenue Survey, so that the present credit of £2,500 allotted for the production of Topographical Maps is insufficient to deal even gradually with the mass of material awaiting publication.

Now that all the provinces under survey have been properly triangulated it has become possible to publish all maps with regular sheet lines so that each sheet is full of detail and correctly joins the adjoining sheets. Under this system there is a slight delay in getting out the sheets of the Revenue Survey, since a map sheet cannot be completed and printed off until all the villages which occur on the sheet have been finished. On the other hand there is a great advantage in the new arrangement when a map is wanted of the lands situated along a canal or road which traverses several villages. Under the old system the maps of each different village had to be cut up and pasted together to form a continuous map.

The instruction class during the year trained 108 pupils for the different branches of the Department :— Instruction.

For Revenue Survey	60
.. Topographical Survey	25
.. Theodolite Traverse	19
.. Town Survey	4
	<hr/>
	108
	<hr/>

The total wastage from various causes was 31 :—

Discharged for unsatisfactory work... ..	14
Discharged for misconduct... ..	10
Resigned for ill health... ..	5
Resigned... ..	2
	<hr/>
	31
	<hr/>

Seven Surveyors were promoted to be Engineers.

* The sheets of Behern Province were of a special size and included 21 square kilometres.

The Department Library has increased considerably during the year:—

	Books & Pamphlets	Maps
In the library 1st January 1902	2138	650
Purchased in 1902	184	18
Presented in 1902	334	63
In the Library 31st December 1902	2656	731

Sales.

The sale of Maps and Publications shows a steady though not a rapid increase, but there are signs that these sales are on the point of becoming considerably larger:—

YEAR	Printed maps.	Publications.	Tracings.	Total.
	£s.	£s.	£s.	£s.
1898	—	—	—	141.5
1899	145.8	—	139.5	285.3
1900	125.8	15.7	426.9	568.4
1901	214.9	48.8	537.6	801.3
1902	292.0	90.2	628.9	1,011.1

The work of the Map Store has very largely increased both in the registering and storing of new material and in furnishing applicants with maps and information:—

STATEMENT OF PRINTED MAPS, ETC., IN STORE

	Maps.	Publications.
In store 1st January 1902	98,000	21,474
Received during 1902	205,318	86,237
Issued during 1902	87,223	16,648
In Store 31st December 1902	216,095	91,063

The issues show a large increase on those of previous years:—

YEAR.	Maps		Publications	
	Free. ¹	On payment.	Free.	On payment.
1900	20,453	906	1,738	103
1901	24,550	2,847	2,009	235
1902	88,086	4,137	15,817 ²	801

The cost of the survey of a square kilometre (238·05 feddans) for the Revenue Survey is:—

	1901	1902
	£E.	£E.
Major triangulation	0.339	0.469
Minor "	0.579	0.718
Theodolite Traverse... ..	2.200	1.440
Detail Survey	3.399	3.335
Compilation of Registers	2.747	1.668
Cost per square kilometre	9.264	7.630
Cost per feddan in millimes £E.	37.8	32.0

To this there should be added the cost of supervision checking, etc.:—

	Per sq. kilom. £E. Mill.
Salaries of Inspectors	0.880 ²
(Clerical, and checking staff, etc., for all correspondence, maps and plans	0.750 ²
Triangulation and traverse computation	0.560 ²

I much regret to have to record the death of M. H. Ravyon Bey who for 16 years had been in charge of the Drawing and Lithographic Office of the Public Works Ministry. He was taken ill in December 1901, and died in February 1902. He had formed the Office and trained the staff of it, and the maps printed for the use of the Irrigation Department were produced under his supervision. He has been succeeded by Mr. R. M. Hansard.

There has been a steady improvement in the quality and out-turn of the work of the Department and this is mainly due to Messrs. Humphreys, Craig and Hansard who have been ably seconded by the other Inspectors.

¹ To Government Departments.

² Mostly Monthly Meteorological Observations, sent to Government Departments & other weather Services and Observatories.

³ Data for 1901 were insufficient to furnish corresponding figures.

Triangulation.

During the year 1902 the minor triangulation of the provinces of Qaliubia and Daqablia was completed, as well as the greater part of the major triangulation of Qena and Girga. Considerable progress was made with the minor triangulation in these provinces and several other small pieces of triangulation were done for special purpose.

In consequence of the introduction of perennial irrigation in the Mudirias of Assiut, Minia, and Beni-Suef, the cadastral survey of these provinces had to be commenced in Upper Egypt in the provinces of Qena and Girga for the cadastral survey of this part.

Triangulation
field work
Major
triangulation.

The general plan adopted for the major triangulation is to extend a line of quadrilaterals along the Nile valley, connecting at intervals of about 100 to 150 kilometres with base lines where astronomical observations are taken. The part between two base lines is reduced as a whole and adjusted to give consistency between the values of the various elements deduced from the observations at each end, a method that prevents the accumulation of error which might result were the triangulation of the whole valley made to depend on measurements at one place. It need hardly be said that it subjects a triangulation to considerable strain to expect it to give accurate positions of the stations at a distance of say 500 kilometres from the base. Even if the angles were correct, an error of only 2" in the initial azimuth would cause a displacement of the terminal stations by 5 metres.

Base lines.

In pursuance of the general plan indicated above, bases for the Aswan Qena-Girga triangulation have been laid down:—

- (1) Near Aswan.
- (2) At Gebelên, Merkaz Luxor.
- (3) At Ambir, Merkaz Nag Hamâdi.
- (4) Near Girga, Merkaz Tenna,

though it has not yet been necessary to measure the first and fourth.

The Gebelên and Ambir bases were measured in a manner similar to that employed at Abbassia (v.P.W.D. Report for 1901 p.331) with the following results:—

Gebelên base.	North Segment	South Segment.
	Metres.	Metres.
Measuring N-S	1052.6236	1253.6819
Measuring S-S	1052.6251	1253.6616
Mean	1052.6244	1253.6719
Resulting lengths	2306.2961 metres.	
Probable error	1.0 c.m. or 1 in 230,000	

It is worthy of note that this line was measured under exceptionally unfavourable meteorological conditions, the thermometer standing at well over 30° C. with fresh to strong breezes blowing most of the time.

Ambur base.	North Segment.	South Segment.
	Metres.	Metres.
Measuring N.-S.	1149.993	1175.477
Measuring S.-N.	1150.055	1175.464
Mean	1150.024	1175.470
Resulting length... ..	2325.494	
Probable error	2.1 cm. or 1 in 111,000 *	

When a series of observations on the Jaderin wires and comparisons with the Brunner standard 4-metre bar has been carried out, it is hoped that still better results will be attained, but up to the end of the year the bar had not arrived from Paris.

In the mean time as the staff employed for this work is practically the same, much valuable experience is being gained.

The cost of the major triangulation was:—

	£E.
Personnel	689
Transport and marks... ..	182
Measurement of base... ..	67
Total... ..	<u>£E.938</u>

for which 1998 square kilometres were triangulated.

STATISTICAL DETAILS.

MAJOR TRIANGULATION.

	Fayum.	Dumakhla Qaliubia.	Qena.
Extent in square kilometres ...	2,077	2,950	1,277
Time taken in days	293	270	153
Stations occupied	53	41	29
Lines observed	123	93	86
Triangles	81	48	66
Average length of side (metres).	8,700	15,000	15,000
Cost (£E.)... ..	703	90	599
Cost per square kilometre (£E.)	0.339	0.437	0.469
Cost per station (£E.)	13.3	31.5	20.7
Average error of closure of triangles... ..	3.8	2.4	2.19

Part of Girga reconnected but not observed.

* Not the final value.

Minor Triangulation.—Practically only three parties and sometimes only two were available for this work from various causes in the early part of the year. In this time the remaining part of the Qaliubia-Daqahia minor triangulation was completed, and a start was made in Girga, but it was not till October that any serious work was begun in Qena. Four parties distributed this province amongst them, and by the year nearly the whole had been reconnoitred and about half observed.

The total cost of minor triangulation was:—

	£E.
Personnel... ..	1,207
Transport... ..	149
Marks	74
	<u>£E.1,430</u>

For this sum an extent of 1,400 square kilometres was covered with minor triangles.

MINOR TRIANGULATION.

	Fayoum	Qaliubia	Daqahia	Qena	Girga
YEAR	1900	1901-2	1901-2	1902	1902
Extent in square kilometres ...	2,100	930	2,520	580	300
Time taken (days)	467	443	1,034	236	113
Stations occupied	239	222	574	115	42
Lines observed	654	537	1,446	345	100
Triangles	350	357	902	181	104
Average area in square kilom....	6.4	2.6	2.8	3.2	2.8
Average length of sides (metres).	4,500	2,800	3,100	3,200	3,000
Cost (£E.)	848	562	1,475	446	205
Cost per square kilometre (£E.)	0.402	0.604	0.585	0.768	0.683
Cost per Station (£E.)	3.55	2.53	2.57	3.88	4.88
Average error of closure of triangles	6.6	3.7	4.5	3.3	3.2

Theodolite
traversing.

On the accuracy of the points which are laid down in this portion of the survey work depends to a great extent the rapidity of the detail survey. The reorganisation of this part of the Department was entrusted to Mr. E. M. Dowson in the autumn of 1901, and the effect began to show by the end of that year. During 1902 the improvement was maintained, and by increasing the staff it was possible to provide the Survey Taftishes with their fixed points sufficiently rapidly to avoid the delays which had occurred in the previous year.

During this year there were traversed :—

	Fiddans	Points	Kilometres chained.
Daqahlia	140,335	8,392	2,610
Quliubia	342,748	19,269	6,643
Total... ..	483,083	27,661	9,253

The cost was :—

	£ E.
Salaries	2,406
Travelling and other expenses	166
Freight and cost of marks	350
	<u>£ E. 2,922</u>

These data as compared with 1901 are :—

	1901	1902
Cost per square kilometre.. £ E.	2.200	1.140
Cost per point £ E.	0.140	0.105
Points per square kilometre	16	13
Kilometres chained per square kilometre.	4.00	4.55
* Average number of points per Surveyor per day	7	15
* Average length chained met.	1,660	4,818

The work too has been much more accurate, only a small number of villages having been rejected by the Computing Office as not falling within the prescribed limits of accuracy. This marked increase is partly the result of more satisfactory organisation and also of the present system of training young surveyors specially in the use of the theodolite and placing them in groups under Engineers for supervision, instead of employing the Engineers to do the actual traversing. The present system has proved to be more accurate, more expeditious and more economical than the old one. This experience only bears out what has been found in other branches of survey work, namely that there is no difficulty in training young Egyptians to do good work if they are effectively controlled and supervised, but to leave them alone to arrange and carry through a piece of survey, especially if it contains

* Including the days spent in putting down marks determining boundaries, making up lists of points, &c.

work of different kinds, leads to slow and often bad work. The best and cheapest results are obtained by dividing the work into successive stages and by providing ample supervision. The admissible errors for this class of work are given in the following tables :—

ANGULAR MEASUREMENTS.

No. of Sides	2	4	6	8	10	15	20	25	30	35	40
Error in angle	2.1	3.0	3.7	4.2	4.7	5.8	6.7	7.5	8.2	8.9	9.4

LINEAR MEASUREMENTS.

Sum of the Sides.	Maximum admissible error.		
	Good ground.	Average ground.	Bad ground.
metres.	metres.	metres.	metres.
200	0.32	0.39	0.45
400	0.49	0.60	0.69
600	0.65	0.79	0.92
800	0.80	0.98	1.13
1,000	0.95	1.16	1.34
1,500	1.31	1.61	1.86
2,000	1.67	2.05	2.36
2,500	2.03	2.48	2.88
3,000	2.39	2.92	3.38

In general the angular errors fall well within the prescribed limits, while the errors in chaining, though less satisfactory, do not exceed the limits.

Revenue
Survey.

At the beginning of 1902 work was in progress in the Fayum and in Menufia provinces, and it was only with the greatest difficulty that they were completed in time for the work of reassessment. As it was, the necessity for working 10-12 hours per day and even more, tended to make the work done less accurate than it otherwise would have been. By the end of the summer the whole staff was working in Daqahlia and Qaliubia where work has gone much more quickly than in Fayum and Menufia as the theodolite traverse was better and there was less interference with the marks.

The area surveyed is shown in the following table though the total area, which was in hand at the end of 1902 and will be completed early in 1903, can only be approximately stated:—

MARKAZ.	1901-2		1902		1902-3		Total.	Remarks.
	No. of Villages.	Feddans.	No. of Villages.	Feddans.	No. of Villages.	Feddans.	Feddans.	
Etsa	9	134,938	2	10,696	—	—	145,634	Area given in column 1902-3 are approximate only.
Fayum... ..	16	61,064	4	17,228	—	—	78,292	
Sannares	18	120,299	1	4,023	—	—	124,322	
Menuf... ..	37	62,048	—	—	—	—	62,048	
Quesna... ..	21	30,371	18	25,495	—	—	55,866	
Shibin el Kom ...	21	29,155	19	24,947	1	3,228	57,330	
Tukh	—	—	24	16,370	35	58,651	75,021	
Nawa	—	—	24	27,168	17	32,186	59,534	
Dawâhi Masr ...	—	—	1	1,323	12	11,083	12,406	
Qaliûb... ..	—	—	—	—	30	49,599	49,599	
Fareskur	—	—	—	8,471	21	35,573	44,044	
Dekernes	—	—	—	—	17	18,543	18,543	
El Mansura ...	—	—	10	7,701	50	70,077	77,778	
El Simbellawen ...	—	—	26	28,769	22	36,717	65,486	
Mit Ghaur	—	—	19	12,047	5	7,813	19,860	
Total... ..	—	437,875*	—	184,238	—	323,470	945,583	

* This total does not agree with that in p. 338 of Public Works Ministry Report, 1901, since the figure there given was only estimated.

The table given last year* to show the subdivision of the land into holdings is here repeated with the addition of the data furnished by the villages which were surveyed during the year.

AVERAGE SIZE OF PLOT.

MARKAZ	Number of Villages.	Total No. of Plots.	Plots under 12 qdras.	Percentage.	Plots under 5 foldans and over 12 qdras.	Percentage.	Plots over 5 foldans.	Percentage.
Etsa	31	40,080	15,655	39.1	21,072	52.6	3,353	8.3
Fayum	25	39,469	18,474	46.8	18,781	47.6	2,214	5.6
Sannures	29	45,576	20,412	44.8	22,443	49.2	2,721	6.0
Shibin el Kom... ..	59	56,505	21,644	38.3	33,589	59.4	1,272	2.3
Mentuf	58	62,107	21,158	34.1	39,478	63.5	1,471	2.4
Quesna	61	38,005	10,499	27.6	24,718	65.0	2,788	7.4
Ashmun	32	31,362	11,233	35.8	19,049	60.7	1,080	3.5
Tala	55	53,767	18,965	35.2	32,515	60.5	2,287	4.3
Tukh	21	10,894	4,839	44.4	5,612	51.5	443	4.1
Nawa... ..	24	16,825	6,676	39.7	9,438	56.1	711	4.2
Dawahi Masr	1	103	14	13.6	50	48.5	39	37.9
El Mansura	10	4,491	1,940	43.2	2,333	51.9	218	4.9
Fareskur	12	1,731	507	29.3	937	54.1	287	16.6
El Simbellawen	26	9,145	2,565	28.0	5,447	59.6	1,133	12.4
Mit Ghanur	19	4,772	1,310	27.5	3,017	63.2	445	9.3
Embaba	35	32,891	9,852	30.0	20,758	63.1	2,267	6.9
Giza	25	12,765	3,546	27.8	7,141	55.9	2,078	16.3
Ayat	17	15,385	7,356	47.8	7,199	46.8	830	5.4
Saff	26	20,868	6,803	32.6	12,925	61.9	1,140	5.5
Barollos	2	86	19	22.1	44	51.2	23	26.7
Sherbin	6	6,413	865	13.4	3,020	47.0	2,528	39.6

* Report on Public Works Ministry, 1901, p. 341.

The rate of work and the cost is given in the following table for 282 villages for which the data were complete during the year 1902.

TIME AND COST OF REVENUE SURVEY PER 100 FEDDANS.

MARKAZ.	No. of Village.	Area in Feddans.	Days per 100 feddans.		Cost per 100 feddans.			
			Field Work.	Records.	Field Work.		Records.	
					£ F.	MILL.	£ F.	MILL.
Etsa	11	145,634	2.15	1.18	0	493	0	256
Fayum	20	78,292	6.77	2.85	2	108	0	591
Sannures	19	124,322	6.05	2.35	1	281	0	342
Menuf... ..	37	62,048	6.08	10.58	1	289	1	393
Quesna	39	55,866	6.89	7.19	1	646	1	018
Shibin el Kom	40	54,102	8.87	5.51	2	633	0	943
Tukh	24	16,370	6.69	6.25	1	537	0	981
Nawa	24	27,168	4.38	4.50	1	153	0	684
Dawahi Masr	1	1,323	6.05	1.59	1	083	0	151
El Mansura	10	7,701	5.21	5.22	1	150	0	895
Fareskur	12	8,471	5.09	5.53	1	107	0	382
El Sinbellawen	26	28,769	6.19	2.36	1	351	0	374
Mit Ghamr	19	12,047	6.64	10.65	1	336	1	124
Average... ..			5.92	5.04	1	400	0	700
Average in 1901*			5.45	5.51	1	428	1	154

In 1902 the Computation Office was engaged in the reduction of the major triangulation of Qena, the remainder of the minor triangulation of Qaliubia and Daqublia and the preparation of the traverse maps in part of the Fayum, and in Qaliubia and about half of Daqublia. A triangulation to serve as the basis of a town map of Alexandria was also computed and plotted, and traverse computations for the town maps of Suez, Mit Ghamr, Mansura and Helwan were also prepared. Much other incidental work was also completed during the year, such as the computation of a Compass Survey of the Bahr el Gebel, the adaptation of the Gharbia maps to the map system adopted, and the observations and computation of the constants of several current meters employed by the Department during the year. Other work will be referred to in its place.

Computation Office.

* Report of Public Works Ministry, 1901, p. 332

Map
Projection.

When in the beginning of the year it became necessary to bring out maps of Gharbia on the scale of 1/10,000, an examination of the triangulation of 1897 was made and it was decided as a result to fit this province and also Menufia into the general scheme of projection, so far at least as the topographic maps were concerned. Some of the northern stations were found to be almost identical with those of the Daqahlia triangulation, and the calculation of the coordinates of several points was carried out. The work however had not extended sufficiently far south along the Damietta branch at the end of 1902 to enable an estimate of the success of the junction to be formed.

Traverse
Computation.

When the calculation of the villages traversed in Qaliubia and Daqahlia began, it was apparent that a marked improvement in the quality of the traverse work had been effected by reorganisation carried out in 1901. Corrections were much less often required, and where necessary it was frequently possible from the nature of the error made to indicate the point where remeasurements must be made instead of requiring a retraverse of a whole line as was frequently the case in the Fayum.

The output of work has shown a marked increase this year as will be seen from the annexed table:—

COMPUTATION OFFICE STATISTICS.

	1901	1902
Points computed	43,000	53,126
Length of lines computed ...	—	12,142 km.
Sheets plotted	2,390	5,026
Area computed	—	875,041 fedd.
Villages computed	—	510
Total cost	—	£E.2,079 *
Cost per feddan... ..	—	2.38 mill. *

Not only has the quantity been improved, but by the introduction of various methods of checking, the quality has also been materially bettered.

Calendars.

One of the duties of the Computation Office is to prepare the different almanacs and calendars issued by the Egyptian Government, at least as far as the astronomical part of each is concerned. It will be

* Both triangulation and traverse computations included.

convenient therefore to state shortly the system adopted in fixing the Arabic months. It appears not to be generally known that the Mohammedans have really two calendars, both lunar but differing in that the first or vulgar reckoning depends on the actual sight of the new moon, while the second or civil reckoning is based on astronomical calculations of the mean lunation. The latter was introduced in 17 A. H. by Omar ben el Khattab, and has been employed ever since for historical purposes. From their observations the Arabic astronomers arrived at a cycle of 30 years (Mohammelan), eleven of which contain an intercalary day, and their computations give so close an approximation to the true value of the mean lunation that the conventional months of this calendar never differ by more than one, or exceptionally two days from those of the vulgar reckoning. As, however, all the religious festivals and fasts on which official holidays depend, are regulated by the latter, it is with this that we are here concerned. The Arabic day begins at sunset, and the particular day which commences any month is that on which the new moon is first seen after sunset. Apart from the cloudiness of the sky there may be and generally is considerable difficulty in seeing the crescent, lost as it must always be in the radiance of the set sun, and consequently there is always uncertainty for some time after sunset, whether the day that has just begun is to be reckoned with the last month or as the first of a new month. Since it is manifestly impossible to foretell months in advance whether the moon will or will not be visible on a particular night, some convention must be adopted in the compilation of an almanac. That taken for the purpose of the various official almanacs, after consultation with several of those best qualified to express an opinion on the subject, is that the moon will not be visible unless it remains above the horizon for a period of at least fifteen minutes after sunset; this was also the rule followed by the late Ismail Pasha el Falaki. This gives a definite rule to go by which is found to work out satisfactorily in practice. However, as mentioned above, there may be divergence between the two reckonings to the amount of two days, a possibility which has given rise to the Arabic custom of adding the day of the week to that of the month in quoting dates, when all ambiguity is removed.

As a certain amount of material was annually accumulated in the computation of the calendar, it was decided late in 1901 to bring out in two editions, English and Arabic, an Official Almanac which might be of use to Government Offices and to the public. This was done early in the year and the amount of support accorded it was sufficient to justify its continuance and enlargement for 1903.

The almanacs now prepared are:—

- (1) Date Calendar ;
- (2) Natiga or Arabic Calendar giving hours of prayer;
- (3) Imsakiia or Special Calendar for the month of Ramadan;
- (4) Government Almanac for the Gregorian year;
- (5) Arabic edition for the same for the Mohammedan year;
- (6) The Calendar of the Sudan Almanac for the Sudan Government.

**Meteorological
Service.**

The chief work of the year has been the improvement of the meteorological reports from the stations mentioned in last year's report. As the observers were almost all quite new to the work, it was preferable to wait till they had acquired some facility before attempting the opening of more new stations. However arrangements were in progress at the end of the year for commencing a systematic measurement of rainfall in the Delta and western part of the Mediterranean coast. The question is of some practical importance in connection with the regulation of drains in Lower Egypt. It is hoped also that a second order station may soon be introduced at Tanta or some other mid-Delta town.

Partly because the site of the second order station at the Barrage was defective, partly to give details of the climatic conditions in the cultivated area which cannot be derived from those at Abbassia, and partly in view of the impending change of the Observatory to Helwan, the station existing at the Barrage was on 1st January transferred to the lawn in front of the Survey Department at Giza.

Early in the year a monthly resumé of the weather was commenced that the general public might have statistics of the month's weather without waiting for the publication of the more detailed bulletins from each station.

Forecasts were issued during the early and late months of the year, but were discontinued during the summer when the stability of meteorological conditions render them unnecessary.

It would be greatly in the interest of agriculture to increase considerably the stations in Upper and Lower Egypt; and to arrange for a systematic publication of results.

The Meteorological Report for 1900 has been in the press since October 1901, but is not yet published.

**Drawing and
Lithographic
Office.**

In the Drawing Office there has been a very marked improvement. Mr R. M. Hausard has reorganised this section of the Department to

bring it up to the present increased requirements. The work now done may be classified under the heads:—

- (a) Cadastral Maps;
- (b) Topographical Maps;
- (c) Maps and Plans prepared for special purposes;
- (d) Tracings;
- (e) Line and Process blocks for illustrations.

The Cadastral Maps are produced by autography from the original field sheets on the scale of 1/2,500, and the drawing transferred to zinc, from which an edition of about 50 copies is printed, and the zinc sheet is stored. They are in arabic only.

The cost of a single sheet 443 millimetres by 478 millimetres and containing 36" lat. by 45" long. is:—

	£E. Mill.
Drawing, writing and correction... ..	0 330
Transferring and printing	0 055
Zinc sheet and materials	0 100
Paper	0 235
Total... ..	<u>£E.0 720</u>
As compared with	<u>£E.1 725 in 1901.</u>

The area represented is on the average 320 feddans on each sheet. The work is the same and is done by the same employes, the difference being due solely to improved organisation which has improved the quality of the drawing and greatly reduced the number of corrections necessary.

The topographical maps on a scale of 1/10,000 are prepared from the revised sheets which are received from the field parties. These are compiled and fair drawn and then lithographed in black, blue and green. For Behera Province where no triangulation was available, rectangular sheets 60 centimetres by 40 centimetres have been published, of which the sheet lines are arbitrary and do not correspond with parallels and meridians. The average cost of 150 copies of a single sheet containing 24 square kilometres is:—

	£E. Mill.
Drawing	1 059
Lithography.	1 250
Printing	1 075
Paper	1 380
Total... ..	<u>£E.4 764</u> or 32 mills. per copy.

This is about half what the first sheets cost which were prepared at the end of 1901 when the staff were quite new to the work. They are in Arabic only.

In North Gharbia it has been possible to utilise the old triangulation since the new triangulation of Daqahlia alongside it furnished a check and a means of correcting it. Consequently the topographical maps of Gharbia have been published as part of the general scheme for the maps of Egypt, and have sheet lines corresponding to meridians and parallels. Each sheet contains 25' lat. and 30' long. The sheets are similar to those of Behera, but sand hills and desert areas are shown in colour and all writing appears both in English and Arabic. The average cost of preparing 200 copies of a sheet containing 21 square kilometres is:—

	£E.	Mill.
Drawing	1	211
Lithography	1	250
Printing	1	400
Paper	1	950
Total... ..	£E.5	811 or 29 mills. per copy.

From these, maps on a scale of 1/50,000 are being reduced, and for this purpose photography will be utilised.

Arrangements have been made whereby line and half tone blocks on zinc and copper can be prepared in the Survey Department for illustrating reports, etc. So far the amount of this work has been small but it will probably increase.

The staff of the Drawing and Reproduction Office was:—

	European.	Egyptian.	Total.
Superintendents	3	1	4
Lithographers	7	1	8
Autographers	—	21	21
Draughtsmen-1st Class	5	6	11
-2nd Class	1	11	12
Arabic Writers... ..	—	6	6
Printers	4	1	5
Assistant Printers	1	15	16
Mounters	—	2	2
Total... ..	21	64	85

STATEMENT OF MAPS AND PLANS PRINTED.

	1900.	1901.	1902
Topographical Map Sheets	—	—	124
Cadastral Map Sheets	840	1155	4348
Extra-Departmental Maps and Plans ...	—	—	31
Maps and Plans for Geological and P.W. } D. Report	34	176	30
Circulars, Survey Forms, etc... ..	—	—	108
Tracings : Departmental... ..	(no record)		185
On Repayment	(")		661
Total	874	1331	5487

Mr. Kearney joined the Department in September to take charge of the Photographic Section of the Drawing Office, and was occupied during the remainder of the year in arranging the apparatus and in experimental work. By the commencement of 1903 all was in readiness for the systematic employment of photography for the reproduction of maps and plans.

The work of the Geological Staff has been considerably delayed by the employment of one throughout the year taking a series of river discharges in the Sudan. Besides this the arrangement of the Museum has been proceeded with and is nearly complete. In the winter of 1901-2 and in the autumn of 1902 Mr. Beadnell continued work in the desert north-west of the Fayum and considerably increased the collection of fossil animals from this site. At the request of the Trustees of the British Museum, Dr. A.C. Andrews worked for a short time on the same site for that Museum. In May the Egyptian Government presented a set of duplicate specimens from this locality to the Trustees of the British Museum for the collection of the Natural History Department of that Museum.

The following tables show the nature and amount of the work done in the Laboratory during the past twelve months:—

TABLE I.

Section.	No. of Samples examined.
Chemical Section	225
Physical Section	137
Total... ..	362

TABLE II.

From.	No. of Samples examined.
Public Works Ministry:—	
Survey Department..	127
Tanzim Department..	62
Irrigation Department	26
Department of Antiquities	2
Finance Ministry.	8
Ministry of Interior; Prisons Department	5
Ministry of War..	9
Non-Government Sources..	123
Total... ..	362

TABLE III.

Nature of Sample.	No. of Samples examined.
Geological Specimens (Ores &c.)	8
Building Stones... ..	91
Cements, Hydraulic Lime and Mortar... ..	144
Other Building Materials (Paints &c.)... ..	27
Soils	35
Water	26
Miscellaneous	28
Total... ..	362

TABLE IV.

Fees Received from.	Amount.
	£ E. Mill.
Public Works Ministry; January to October (Since October all work done free of charge)	71,550
Government Departments not in Public Works Ministry.	9,600
Non-Government Sources..	32,600
Total... ..	116,750

At the end of 1899 a small Laboratory consisting of three rooms was built near the Ministry of Public Works. This was finished and fitted up at the beginning of 1900. Each year the work has increased, and in 1902 the number of samples examined was 47 % in excess of those examined in 1900. This increase of work has necessitated an increase in the Laboratory accommodation, and two extra rooms have since been added.

When the Laboratory was first established only chemical work was undertaken; in 1902 however a physical section was added, and now physical as well as chemical tests are carried out. In March 1902 the testing of cements and hydraulic limes for tensile strength, fineness of grinding, etc., was taken over from the Tanzim Department, and about the same date a large stone-crushing machine was received and erected, so that at the present time a complete testing of building materials can be made. A room is now being fitted up as a gas testing laboratory, and a complete equipment of modern gas testing apparatus has been received from Paris. In future the gas of Cairo will be tested regularly for purity, pressure and illuminating power.

In addition to the actual testing of samples the laboratory has furnished from time to time technical advice on a number of paints, artificial stone, cement, etc., and the cause and remedy for unsightly and damaging efflorescences of salts on some of the recently erected public buildings.

Two Reports have also been published, one on the disintegration of building stones in Egypt, and the other on the soil and water of the Fayum. A special Report by Mr. A. Lucas, chemist to this Department, on the water and soils of the lands in the Wadi Tumilat now under reclamation, is attached as an appendix to this Report.

The progress that the Laboratory has shown during the past three years indicates that analytical work is needed and appreciated, but it is much to be regretted that more has not been done, since the scope of such work is practically unlimited. Adulteration of materials is undoubtedly very prevalent in Egypt and has almost become a profession, and yet very little effort is made to check it. Users of materials practically place a premium upon adulteration so long as they buy articles of the quality of which nothing is known beyond the statements made by those interested in selling them.

Sometimes it may be that the samples submitted with the tender are analysed, but rarely, if ever, is there a systematic and periodical examination of the material afterwards delivered to see whether or not it comes up to the tender sample. It may happen also that the material

delivered is quite good enough for the purpose for which it is to be used, but very frequently it is not as specified and not worth the price paid.

Paints are trebly adulterated; the basis of the paint is not pure, the oil with which it is ground is not the genuine linseed oil represented, and the turpentine mixed with it contains petroleum.

Expensive American petroleum is adulterated with Russian at half the price. The flash point of illuminating oils is so low as to be very unsafe, and lubricating oils are not the pure mineral oils paid for.

If an article supplied happens to be of good quality and satisfactory in use, this is due largely to the fact that the firm supplying it is honest, and is not owing to any efforts made to control the purity of the supply.

The only safe and economical method of buying is to buy against a specification, and to make sure, by analysis, that the article supplied is equal to that specified.

H. G. LYONS.

Director General Survey Department.

APPENDIX.

A REPORT

ON THE

SOIL AND WATER OF THE WADI TUMILAT LANDS UNDER RECLAMATION

SITUATION.

THE Wadi Tumilat is a long narrow strip of land extending almost due east and west between the cultivation of the Nile delta near Abbassa and Lake Timsah at Ismailia. The valley is bounded on both the north and the south by desert.

CLIMATE.

No meteorological observations have been taken in the Wadi Tumilat itself, but the climate is a typical Egyptian desert climate characterized by abundant sunshine, high temperature during the day, relative low temperature at night and a very small annual rainfall.

The following figures will serve to convey an approximate idea of the general climatic conditions. Table I gives the results of observations taken at Ismailia, while Tables II, III and IV are from observations made at the Observatory near Cairo.

TABLE I.—ISMAILIA.¹

ANNÉE 1896	Température moyenne.					Humidité relative.			Pluie.	
	7 h. 30	14 h.	17 h.	Minimum	Maximum	7 h. 30	14 h.	17 h.	Hauteur en millimètres.	Nombre de jours.
Janvier ...	9.81	17.43	14.76	8.40	18.56	82.2	48.9	56.4	6.9	12
Février ...	10.73	19.74	17.39	8.92	21.00	81.1	42.0	49.3	4.0	8
Mars ...	13.73	22.17	19.84	10.80	23.43	77.7	39.4	43.3	6.1	9
Avril ...	16.01	25.97	23.01	12.57	26.71	71.3	32.3	38.2	1.2	4
Mai ...	20.42	30.17	26.16	17.41	31.69	63.8	28.3	41.6	2.7	5
Juin ...	21.55	32.50	28.40	18.10	33.84	80.1	30.9	41.8	0.0	0
Juillet ...	23.49	35.33	31.42	21.29	35.22	85.6	38.8	44.1	0.0	0
Août ...	24.39	35.53	31.66	22.31	36.27	85.2	34.2	43.6	0.0	0
Septembre ...	22.92	32.52	29.46	19.52	33.54	80.5	38.7	50.2	0.0	0
Octobre ...	20.01	30.16	26.25	17.43	31.02	..	..	..	..	..
Novembre ...	15.50	26.26	22.51	13.37	27.22	86.7	39.4	52.4	0.0	2
Décembre ...	11.89	22.46	18.71	10.18	23.34	83.8	50.1	61.6	2.8	4
	17.54	27.52	24.13	15.02	28.54	..	..	..	..	..

¹ Annales du Bureau central météorologique de France, Paris 1898, année 1896, t. II. Observations.

TABLE II.—CAIRO.¹

Temperature.—Monthly Absolute Maxima and Minima for 15 years, 1894-1898.

MONTH.	Absolute.	
	Maximum.	Minimum.
	°C	°
January	26·6	-0·7
February	35·3	1·2
March	41·2	3·2
April... ..	42·6	5·7
May	44·2	9·0
June	45·2	13·7
July	44·3	17·4
August	41·6	16·5
September	40·6	14·0
October	42·1	12·1
November	33·6	3·5
December	29·4	1·3
Extreme values	45·2	-0·7

TABLE III.—CAIRO.¹

Rainfall in Millimetres for 12 years, 1887-1898.

MONTH.	1887	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	Mean.
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
January ...	6·35	3·85	3·50	23·50	8·85	1·15	6·00	1·00	..	15·85	0·70	7·50	6·52
February ...	8·25	1·40	1·50	1·25	2·75	0·90	1·20	8·25	0·10	4·25	2·70	..	2·96
March ...	1·60	..	..	21·10	6·25	0·20	12·35	3·45	..	2·20	0·30	8·40	4·65
April... ..	0·45	6·25	0·10	0·10	..	0·60	..	..	14·70	2·30	..	..	2·04
May ... ..	..	12·60	..	..	..	0·10	..	1·10	1·40	3·50	0·10	..	1·57
June... ..	..	1·15	..	..	..	..	..	..	..	..	..	..	0·69
July ... ..	..	..	..	..	..	..	..	..	..	..	..	..	..
August ...	..	..	..	..	..	..	..	..	..	..	..	..	..
September ..	..	..	0·20	..	0·05	0·15	0·25	0·05	..	..	0·10	..	0·07
October ...	0·05	..	0·40	..	6·10	0·15	0·10	0·15	..	..	..	..	0·58
November..	..	10·80	1·25	3·00	0·05	1·20	3·80	2·50	26·90	..	0·70	22·70	6·08
December..	5·20	4·80	9·45	5·50	16·55	2·30	9·15	0·10	0·10	8·30	3·00	2·25	5·56
	21·90	43·85	16·40	54·45	40·60	6·75	32·85	16·60	43·20	36·40	7·60	40·85	30·12

¹ "Report on the Meteorological Observations made at the Abbasia Observatory, Cairo." Survey Department, P.W.M., 1900, pp. 23 and 36.

TABLE IV.—CAIRO.¹

Evaporation, 1902.

MONTH.	Evaporation in millimetres.
	mm.
January	33·3
February... ..	59·9
March	99·9
April	148·6
May	249·6
June... ..	192·6
July	161·4
August	176·7
September	130·0
October	139·2
November	74·7
December	54·8

GEOLOGY.

²“The peninsula of Suez is composed exclusively in its whole breadth from Port Said to Suez, and in the whole thickness displayed in the canal cuttings, of young alluvial and quaternary deposits, these being disposed in such a manner that the centre of the isthmus (from near El Gizr to about half the length of the Bitter Lakes) is taken up by fluvatile fresh-water formations, which to the south pass step by step into the marine beds of the Red Sea, and to the north into those of the Mediterranean. Of fresh-water fossils, casts of *Melania tuberculata*, small *Bithynia* and *Planorbis* have been found on the rise of Gizr; beds of *Etherina semilunata* and in greater quantity *Spatha rubens*, *Vivipara unicolor*, *Bithynia bulimoides*, *Physa contorta*, etc., in the neighbourhood of Ramses, two hours eastward of Ismailia, and in the neighbourhood of Serapeum, *Etherina semilunata*, *Anodonta rubens*, *Bithynia bulimoides*, which are identical with species now living in the Nile. These facts led Capt. Vassel and also Fuchs to arrive at the conclusion that in Diluvial times a stronger arm of the Nile opened in the centre of the present Isthmus into the sea, and with its great mass of fresh water so filled the very narrow and shallow narrowing of the sea that it produced a wall of separation between the two seas, or

¹ Figures supplied by the Superintendent of the Observatory, Cairo.

² “Die Durchfluthung des Isthmus von Suez,” by Dr. C. Fr. Krukenberg, 1888, pp. 28 and 29.

better, between the faunas of both seas, inasmuch as these were unable to pass the sweet water of the Nile Delta, which closed the narrowing of the sea."

EARLY HISTORY.

The Wadi Tumilat formed part of the land of Goshen granted to Jacob and his sons about 1720 B.C. by the ruling Pharaoh, who then described it as being "the best of the land."¹

This description of the district was doubtless however from a shepherd's point of view. ²"In those days probably an overflow channel from the Nile inundated the valley annually during the flood and afterwards drained the lands into Lake Timsah on the waters subsiding. The flooded lands no doubt as soon as the waters retired grew green with fine pasturage, and held in their lowest hollows lakes of sweet water for cattle to drink. So that for Jacob's sons, who were shepherds, the valley was 'the best of the land.'"

³"The extensive deposits of Nile mud in the Wadi Tumilat prove the flow in ancient times of a considerable branch of the Nile eastward into the Red Sea. But a very slight elevation or silting up of the Red Sea would obstruct this arm of the Nile and impair the water communication and the fertility of the district. Of such results we have no evidence till the reign of Seti I, some time before the Exodus, when it became necessary to cut a canal through the Wadi Tumilat, and this canal had to be reopened and extended to the southward by successive rulers down to the Roman Period as the difficulty of maintaining it increased."

"This ancient canal, beginning at Bubastis, watered the land of Goshen with its branches and, entering the Bitter Lakes, changed their character, according to Strabo, and connected them with the Red Sea. From the not inconsiderable remains of the old canal near Belbès it appears to have been about 50 yards (100 ells according to Strabo) in width, and 16 to 17½ feet in depth. The somewhat steep banks are still strengthened at places with solid masonry. According to Herodotus the canal was four days' journey, and according to Pliny 62 Roman miles in length. In ancient times the canal was primarily constructed for purposes of navigation."

¹ Genesis XLVII, verses 6 and 11.

² Major Sir R. Hanbury Brown, *Public Works Ministry Report*, 1899, page 188.

³ "Egypt and Syria," 1894, Sir J. W. Dawson, F.R.S., page 60.

⁴ "Egypt," Baedeker, 1892, page 163.

Some sections of this Pharaonic canal were utilized during the making of the Ismailia Canal, of which they now form a part, and one portion near Kassassin now serves as a section of the main drain.

¹ In 1899 three kilometres which had been in use for irrigation were replaced by new channels.

² In 1901 a further length of "17 kilometres of the old stagnant reed-choked Wadi Canal" was suppressed.

In addition many dry and partly filled up portions exist and may still be traced.

PRESENT CONDITION.

The Wadi Tumilat may be divided into three sections: first, that portion situated round Abbassa and between Abbassa and Kassassin on the south side of the Ismailia Canal, and known as the Wadi Taftish or Wadi Estate; second, that part of the valley lying north of the Ismailia Canal between Abbassa and Kassassin; and third, the entire width of the valley between Kassassin and Ismailia.

Two main waterways traverse the valley from Abbassa to Lake Timsah, one being the Ismailia Canal which conveys water from the Nile near Cairo to Ismailia, and thence by branches to Port Said and Suez, and the other the central drain running almost parallel to it. "The lands have a mean height of 5.25 metres above low water in the Mediterranean and 5.99 metres above the lowest known sea at Suez, or 5.13 metres above the highest tide at Pelusium and 2.83 metres above the highest tide known at Suez."³

The maximum level now cultivated is R.L. 9.0. The water level at Kassassin is 8.50 and at Abbassa 9.20.⁴

About the middle of the valley, south of the Ismailia Canal, is Lake Mahsama; in 1902 the water-level of this lake varied from 5.18 to 5.60 metres above sea level.⁵

The several sections of the Wadi may now be described in detail.

1. THE WADI ESTATE.

In Mohammed Ali's time (1806 to 1849) the total area of this Estate was 21,918 feddans⁶ of which rather less than a third appears to have been cultivated.

¹ *Public Works Ministry Report*, 1899, p. 101.

² *Public Works Ministry Report*, 1901, p. 216.

³ "Mémoires sur les Principaux Travaux d'utilité publique en Egypte," by Linant de Bellefonds Bey, 1872-3, p. 102.

⁴ Figures supplied by the Inspector 1st Circle of Irrigation.

⁵ Figures supplied by the 1st Circle of Irrigation.

⁶ A feddan = 1.636 acre.

¹ In 1861 the Estate was purchased by de Lesseps on behalf of the Suez Canal Company. At this time about 6,000 feddans were under cultivation. After the construction of the Ismailia Canal the Estate was resold to the Khedive Ismail, and in 1865 he made it over to the Ministry of Public Instruction. In 1866 the cultivated area was 12,000 feddans.

² In 1891 the Estate was surveyed and the area found to be as follows:—

	Feddans.
Cultivable land leased	7,560
Cultivable if reclaimed, but uncultivated	9,972
Occupied by canals and uncultivable wastes	3,007
Total... ..	<u>20,539</u>

In March, 1899, the Estate was placed for a period of eleven years under the direction of the Ministry for Public Works, in order that a reclamation scheme might be carried out.

At present about two-thirds of the Estate are under cultivation, the various prizes gained at the Cairo Agricultural Show for Samar,² Rice, Maize, Sesame, Cotton, etc., bearing witness to the general excellence of the crops.³ "At the Agricultural Show the Estate had eight exhibits and obtained seven awards, including a first prize for "Samar" mats, and a bronze medal for Cotton."

In parts, however, more particularly near the Ismailia Canal and at the sides of the main drain, there are areas still waiting reclamation, and here and there among the cultivation are bare patches covered with efflorescent salts.

Many of the fields bearing crops show more or less signs of efflorescence, and in the some places the crops are manifestly poor and stunted. Much efflorescence is visible too at the sides of many of the drains.

¹ *Public Works Ministry Report*, 1890, p. 188.

² *Public Works Ministry Report*, 1890, p. 191.

³ Samar, *Cyperus hirsutus*, a kind of sedge very resistant to alkali.

⁴ *Public Works Ministry Report*, 1901, p. 217.



Sur. Dept. P. W. M.

LOW GROUND WITH EFFLUENCE AT TEL-EL-KEBIR

Several samples of the soil and of the efflorescences have been examined for injurious salts with the following results:—

TABLE V.—SOIL SAMPLES.

Lab. No.	Depth to which taken.	Water.	Sodium Carbonate.	Sodium Bicarbonate.	Sodium Chloride.	Sodium Sulphate.	Total Injurious Salts.	Notes.
	Cents.	%	%	%	%	%	%	
126	0 to 15	5.79	0.053	0.231	0.057	0.062	0.403	1900, Summer; 1901, Cotton; 1902, Helba.
127	0 to 15	9.05	0.106	0.252	0.258	0.104	0.720	1900, 1901, 1902, Samar.
128	0 to 15	5.03	0.172	0.294	0.358	0.177	1.001	1900, Samar; 1901-1902, not cultivated.
129	0 to 15	4.80	Nil	Nil	0.014	Trace	0.014	1900, Samar; 1901, Cotton; 1902, Wheat.
185	Surface	12.92	0.159	0.840	0.775	0.931	2.705	No cultivation.

TABLE VI.—EFFLORESCENCES.

Lab. No.	Sodium Carbonate.	Sodium Bicarbonate.	Sodium Chloride.	Sodium Sulphate.
	%	%	%	%
182	22.26	10.25	10.55	17.81
186	0.53	3.15	19.81	24.81

2. THE SECTION NORTH OF THE ISMAILIA CANAL FROM ABBASSA KASSASSIN.

This is quite a narrow strip of land, and hardly to be distinguished from the adjoining desert, except here and there where some attempts have been made to cultivate a few small patches. At Tel-el-Kebir, however, there is a plantation of young trees belonging to the Government which occupies about 300 feddans.

The low-lying portion immediately bordering the canal is impregnated with salt which frequently comes to the surface as a white efflorescence. This is well shown on Plate XI which is from a photograph of a stretch of low ground situated between the Ismailia Canal and the railway near Tel-el-Kebir; the efflorescence being due to the rise and subsequent evaporation of the seepage water from the canal. A sample of this efflorescence from Tel-el-Kebir was examined and gave the following results:—

TABLE VII.

Lab. No.	Sodium Carbonate.	Sodium Bicarbonate.	Sodium Chloride.	Sodium Sulphate.
	%	%	%	%
187	Nil	1.68	6.60	32.91

3. THE PORTION OF THE VALLEY BETWEEN KASSASSIN AND ISMAILIA.

Kassassin is the termination on the east of the Wadi Estate, and here owing to a difference in levels the drainage-water has to be pumped from one section of the main drain to the section adjoining. The composition of this water at the pumping station, so far as salts harmful to agriculture are concerned, is shown on Table XIII.

About five kilometres east of Kassassin the drain enters Lake Mahsama, through which it flows, being discharged again at the other extremity of the lake, and continuing east passes under the Suez branch of the Ismailia Canal near Nefisha, and finally empties itself into Lake Timsah to the south-west of Ismailia.

Several samples of this drainage-water were taken at various points east of the pumping station at Kassassin, the results of their examination being given in the following table:—

TABLE VIII.
(Parts per 100,000.)

Date.	Lab. No.	Place from which taken.	Total Matter in solution.	Sodium Chloride.	Sodium Sulphate.	Sodium Carbonate.	Sodium Bicarbonate.	REMARKS.
Jan. 15	5	Lake Mahsama North side.	106.4	40.12	25.45	Nil.	63.84	
" 15	6	Drain where it leaves Lake Mahsama.	102.4	36.89	26.06	Nil.	62.16	
" 15	7	Drain where it passes under Suez branch of Ismailia Canal.	105.2	35.59	25.09	Nil.	60.48	
" 15	8	Drain where it enters Lake Timsah.	102.0	30.04	26.06	Nil.	60.48	
" 16	9	Lake Timsah	5375.2	1492.66	..	Nil.	22.68	Lime 94.9 per 100,000 Magnesia 398.76 per 100,000 Sulphur Trioxide 511.68 per 100,000

On comparing the above figures with those on Table XIII, it will be seen that the composition of the water does not differ materially

*Sodium bicarbonate on drying loses water and carbon dioxide and is converted into sodium carbonate, hence in the total matter in solution it would be weighed as 40.28, 39.22, 38.15, 38.15, and 14.30 parts respectively of the normal carbonate.

between Kassassin and Ismailia, and hence the channel serves simply to convey the drainage water to Lake Timsah, and does not act as a drain for that section of the wadi lying east of the pumping station.

Between Kassassin and Ismailia a large part of the valley is uncultivated, the surface for the most part being covered with sand and gravel, near Nefisha however the gravel practically ceases and is replaced by fine sand.

South and south east of Lake Mahsma, also between Abu Suair and Nefisha north of the railway, and south of Nefisha between the Suez branch of the Ismailia Canal and Lake Timsah are salt pools and considerable areas of marshy ground.

The east end of the valley, however, is not altogether barren, for it includes some comparatively large areas of cultivation and great number of small isolated cultivated patches.

“Near Nefisha station, and close to the place where the fresh-water canal to Suez branches off from the main Ismailia Canal, there occurs a greyish marly clay which is made into bricks by the Arabs. This is possibly an old lake bottom, but no shells are to be seen in the workings. Around Ismailia there is a good deal of low-lying ground which has been planted with palm-trees, etc., and which is possibly the filled up part of Lake Timsah. On the skirts of the palm-grove is a piece of marshy ground which has a good deal of salt in it, but its connection with the present lake is obscured by a number of dunes of blown sand. Further out in the desert an opening has been made for the purpose of digging out clay for brick making. This clay is a black, stiff clay which looks like that deposited in lakes. It does not extend far into the desert, and is in all probability connected with the marshy ground nearer Ismailia.

“There is plenty of evidence to show that the lakes covered much more ground formerly than at the present time. There is a good bit of marshy ground near Nefisha station which is shown in old maps as an arm of the Lake Timsah.

“The south-west shore of Lake Timsah is fringed with sand-dunes.

“Among these dunes numerous pools of brackish water occur.”

“Except for a few shells and shell-fragments, the sand of these dunes is all quartz.

“The country between the Wadi Tumilat and Bir Menaif is all submerged beneath blown sand, this sand also stretching westward along the south side of the Wadi Tumilat to the neighbourhood of

¹ Extracted from a manuscript Report by T. Barron, F.G.S., Survey Department, Cairo.

Tel-el-Kebir. In places this sand rises to form low dunes, and beneath the steep leeward slopes of many of these dunes is a muddy deposit impregnated with salt; similar deposits were observed in similar positions in the blown sand near Kassassin."

A sample of the surface soil and several samples of the efflorescence from this section of the Wadi were examined for harmful salts with the following results:—

TABLE IX.

Lab. No.	Nature of Sample.	Place from which taken.	Sodium Carbonate.	Sodium Bicarbonate.	Sodium Chloride.	Sodium Sulphate.
			%	%	%	%
10	Efflorescence ...	Mahsana ...	7.95	3.99	1.15	9.65
11	" ...	" ...	6.62	1.68	0.86	9.43
12	" ...	Nefisha ...	Nil	0.84	1.72	24.74
13	Surface Soil ...	" ...	Nil	Trace	Trace	Trace

NATURE AND EFFECT OF THE INJURIOUS SALTS.

From the analyses of various samples of efflorescences, soil, and drainage-water, the results of which are given in Tables V to IX and XIII, it will be seen that the harmful salts present in the Wadi Tumilat are; sodium carbonate, sodium bicarbonate, sodium chloride and sodium sulphate.¹ These salts, however, are not all equally injurious. Sodium carbonate, as would be expected from the fact that it is a fairly strong alkali, is the most harmful to vegetation, and has a marked corrosive action upon the plant tissues.

"Sodium carbonate has also a very injurious effect upon the physical condition of the soil when the soil contains clay, causing it to shrink in bulk, become extremely sticky, and dry into a stony mass. The presence of 0.08% of sodium carbonate in a heavy soil is sufficient to make it quite untillable."²

Sodium bicarbonate is considerably less harmful than the ordinary carbonate. This fact is clearly brought out in Table V. In sample

¹ The analyses are reported in the usual conventional manner: the alkalinity to phenolphthalein is calculated as sodium carbonate, the alkalinity to methyl orange, after neutralising the sodium carbonate, is calculated as sodium bicarbonate; the whole of the chlorine is shown as sodium chloride and the whole of sulphates as sodium sulphate.

² "Physical Properties of Soil," Warrington, 1900, p. 214.

No. 126 sodium carbonate is present to an extent that alone would just begin to injuriously effect the growth of plants, while sodium chloride and sodium sulphate are not in sufficient quantity to be harmful. There is, however, 0.23% of sodium bicarbonate present, and yet for three years in succession crops were grown. Now since 0.23% of sodium carbonate would be fatal and of sodium chloride would be harmful, it follows therefore that sodium bicarbonate cannot be nearly as injurious as the normal carbonate and not more harmful than sodium chloride. Sample No. 127 brings out the same fact. In this case the amount of the normal carbonate is almost sufficient without the comparatively high percentages of chloride and sulphate also present to account for the soil being only capable of growing Samar. Again therefore the bicarbonate cannot be very harmful or the amount present, namely 0.25%, added to the 0.46% of the other salts would have effectually prevented the land from growing even Samar.

T. H. Kearney, of the U. S. Department of Agriculture, has recently arrived at the same conclusion by direct experiment, and states as a result of his work that "sodium bicarbonate proved to be somewhat less toxic than sodium chloride."¹

It must not be forgotten, however, that under certain conditions sodium bicarbonate becomes wholly or in part converted into the normal carbonate, hence, although not directly very injurious, it may very readily become so, and must therefore be regarded, at any rate, as potentially a harmful salt. The proportion of sodium bicarbonate that is changed into sodium carbonate increases as a rule with increase either of concentration or of temperature, and at 100° C. the whole of the bicarbonate becomes converted into the normal carbonate.

Of the sodium chloride and sodium sulphate the latter appears to be more harmful although on this point there is some difference of opinion.

Warrington states² "plants appear to be more tolerant of sodium sulphate." Stewart found³ that sodium chloride was more injurious than sodium sulphate to germinating seeds of legumes and cereales, and Loughbridge states⁴ that "sulphate of soda is hurtful only when present in very large amount." Means and Gardner state⁵ that "sodium

¹ Report No. 71, U. S. Department of Agriculture, p. 21.

² "Physical Properties of Soil," Warrington, 1900, p. 214.

³ Ninth Ann. Rep. Utah Agr. Expt. Sta., p. 26 (1898) quoted in U. S. Department of Agriculture, Report No. 71, p. 21.

⁴ University of California College of Agriculture, Bulletin No. 133, p. 42.

⁵ U. S. Department of Agriculture, Report No. 64, p. 55.

chloride is the most harmful to plants." Kearney, however, found¹ that for white lupin sodium sulphate was more harmful than sodium chloride.

The order of toxicity as given by Kearney, beginning with the most harmful, is: magnesium sulphate, magnesium chloride, sodium carbonate, sodium sulphate, sodium chloride and sodium bicarbonate.¹

The limits of concentration permitting the roots of white lupin to retain their vitality during twenty-four hours is as follows:—¹

TABLE X.

NAME OF SALT.	Parts per 100,000 of solution.
Magnesium sulphate	7
" chloride	12
Sodium carbonate... ..	26
" sulphate	53
" chloride	116
" bicarbonate	167
Calcium chloride	1377

The order of toxicity of magnesium sulphate and magnesium chloride is reversed by Coupin.² The minimum toxic concentration for sodium chloride, the same plant and the same method being used, is placed about three times as high by True.³

As a close approximation, however, of the limits of endurance for ordinary crops, the following table of values, compiled from the work carried out by the Division of Soils of the U. S. Department of Agriculture may be used.⁴ These figures are in close accord with the results of analyses of alkali soils in Egypt.⁵

¹ U. S. Department of Agriculture, Report No. 71, pp. 21, 54 and 19 respectively.

² *Rev. Gén. de Bot.*, 10, 188 (1898) quoted in U. S. Department of Agriculture, Report No. 71, p. 19.

³ *Amer. Journ. Sci. ser.*, 4, 9, 187 (1901) quoted in U. S. Department of Agriculture, Report No. 71, p. 29.

⁴ U. S. Department of Agriculture, Report No. 64, p. 56.

⁵ "A Preliminary Investigation of the Soil and Water of the Fayum Province." Survey Department, Egypt, 1902.

TABLE XI.

Sodium carbonate	$\left\{ \begin{array}{l} 0.05 \text{ per cent minimum danger line.} \\ 0.10 \text{ per cent maximum limit for growth.} \end{array} \right.$
Sodium sulphate	$\left\{ \begin{array}{l} 0 \text{ to } 0.25 \text{ not harmful.} \\ 0.25 \text{ per cent to } 0.50 \text{ per cent harmful but not sufficient to} \\ \text{and} \quad \quad \quad \text{prevent growth.} \\ \text{Sodium chloride} \quad \left\{ \begin{array}{l} 0.50 \text{ per cent maximum limit for growth.} \end{array} \right. \end{array} \right.$

The limit of endurance of plants for the various harmful salts is dependent not only upon the kind of salt present but varies also with the kind of plant, the age of the plant, the nature of the soil and the kind and extent of other salts present.

Of the crops ordinarily grown in Egypt the most resistant to alkali are Samar, Dinêba,¹ and Rice. Date-palms are also very tolerant of injurious salts.

Samar.—From observations made in the Wadi Tumilat and in the Fayum, in both of which places Samar is cultivated, this crop would appear to be one of the most resistant.

Dineba.—"With 2 per cent of salt in the soil a fair crop of Dineba two feet high can be grown; with 1 per cent it attains its full height of four feet."²

Rice.—This is less hardy than Dineba.

Date-palms.—"In the Sahara date-palms will grow on land containing as much as 3 per cent of alkali."³

The age of a plant also conditions its susceptibility to injurious salts, the younger a plant the more susceptible it is to all adverse conditions, including the presence of alkali.

The amount of alkali tolerated by various cultures varies also with the nature of the soil, being lowest in heavy clay soils and highest in sandy soils.

The modifying effect that other salts have upon the degree of toxicity shown by any one salt when present alone has been brought out in a most marked manner by a series of experiments made by T. H. Kearney, who states that "the addition of a second less toxic

¹ *Dineba*, *Panicum crus galli* a species of millet.

² "The Reclamation of Lake Abukir," by H. E. Sheppard. Minutes of the Proceedings of the Institute of Civil Engineers, London, quoted in "Egyptian Irrigation" by Sir W. Willcocks, 2nd Edition, 1899, p. 251.

³ U. S. Department of Agriculture, Circular No. 9, p. 13.

salt in most cases increases the concentration of solution of the more harmful one in which root-tips can retain their vitality."¹

The following table shows clearly the modifying effect of calcium sulphate and calcium carbonate :—¹

TABLE XII.

SALT.	Parts per 100,000	
	Pure solution.	In the presence of excess of calcium sulphate and calcium carbonate.
Magnesium sulphate	7	2240
" chloride	12	960
Sodium carbonate	26	156
" sulphate	60	2160
" chloride	116	1160
" bicarbonate	167	417

CAUSE OF DETERIORATION.

The ruin of the Wadi Tumilat was brought about by the construction of the Ismailia Canal, which was completed in 1863.

This is a high-level canal passing through a porous soil, and the leakage of water from it must be enormous. This seepage water percolating on the adjoining lands raised the general level of the sub-soil water, in places water-logged the soil, and everywhere within reach brought to the surface the injurious salts that were formerly at a sufficient depth to be out of the way of the roots of the crops, and so harmless.

The canal, however, only made manifest what had been taking place for centuries past ; it did not import into the valley the injurious salts ; these had been accumulating ever since the Wadi ceased to have a natural drainage outlet.

The soil contains calcium carbonate (carbonate of lime) and calcium sulphate (gypsum) together with sodium chloride (common salt). Any water entering the valley from the Nile would also contain sodium chloride (see Table XIV). Each year there would always be a slight rainfall (see Tables I and III). The sodium chloride in the soil would be dissolved, and as the water evaporated a strong solution of this salt

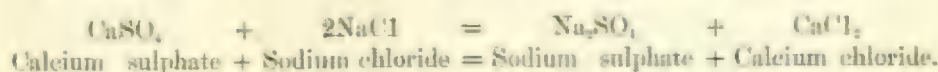
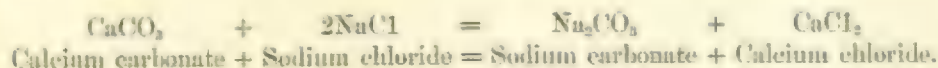
¹ U. S. Department of Agriculture, Report No. 71, pp. 41, 49 and 38 respectively.



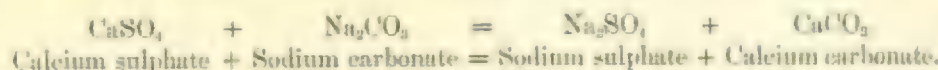
Sur. Dept. P.W.M.

BEFORE RECLAMATION.

would result. This would act upon both the calcium carbonate and the calcium sulphate with the formation of sodium carbonate, sodium sulphate and calcium chloride. These reactions in their simplest form may be represented as follows:—



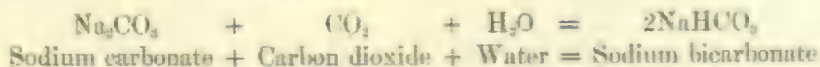
The formation of sodium carbonate would probably be lessened and the production of sodium sulphate increased by the action of the calcium sulphate upon the sodium carbonate thus:—



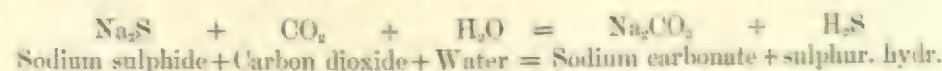
This reaction is sometimes made use of in the United States for the reclamation of lands containing sodium carbonate, calcium sulphate (gypsum) being employed as an antidote, with the result that the very injurious sodium carbonate is wholly or partly converted into the less harmful sodium sulphate.

In California the reclamation of lands made barren by sodium carbonate has been carried out for a number of years, gypsum being applied, turned under and thoroughly watered. “The result has been a very general conversion of the dreaded sodium carbonate into the far less harmful sulphate, and in spots where not a blade of grass would previously grow there have been produced excellent wheat and barley 3 or 4 feet high and full headed.”¹

Sodium bicarbonate would be formed also by the action of carbon dioxide and water upon the sodium carbonate, thus:—



A portion of the sodium bicarbonate would however revert under certain conditions, forming the normal carbonate again. Sodium carbonate might also be produced by the reduction of sodium sulphate to sodium sulphide, as for instance by the action of bacteria, and the subsequent conversion of the sulphide so formed into a carbonate, thus:—



¹ University of California, College of Agriculture, Bulletin No. 133, p. 8.

The calcium chloride formed in the above reactions being extremely soluble would be removed much more rapidly by any slight drainage that might exist, or it would be carried deeper down into the subsoil than the other salts formed at the same time. Thus the calcium chloride would escape and sodium carbonate, sodium bicarbonate and sodium sulphate, together with a portion of the original sodium chloride, would remain. All these salts undoubtedly existed in the soil at the time the Ismailia Canal was made, but they were then brought either to the surface or within reach of the roots of the crops by the infiltration water from the canal, and so the valley became barren.

The one great cause of all the mischief was lack of drainage in the first instance. It may be laid down as a general rule that there cannot be any excessive accumulation of injurious salts in land that is efficiently drained.

RECLAMATION.

The reclamation in the Wadi Tumilat, which is entirely confined to the Wadi Estate, has now been in progress four years with the most satisfactory results, the management being in the hands of the Inspector of the First Circle of Irrigation, in whose district the Estate lies.

At the time the Estate was taken over much of the land adjoining the Ismailia Canal was swampy or actually under water, of the rest some portions were bare and covered with efflorescence, while others supported only rank grass, and less than one-third of the total area was cultivated. Of this cultivated land much was far from good, and, owing to the large amount of injurious salts present, bore only the poorest of crops. Since 1899, however, the main drain has been enlarged and re-modelled, branch drains, field drains and field channels have been dug, and the irrigation system improved. As a result the good land has become better, the poor land is now good, and the former uncultivated area has been diminished by one-half. The condition of the land before reclamation and the methods employed are well illustrated in Plates XII, XIII, and XIV. Plate XII shows a large area bordering the cultivation before being reclaimed and in such a bad state that nothing but a little rank grass will grow. Plate XIII shows a similar area about to be reclaimed and in which the field channels and small drains have already been made, while Plate XIV shows another plot where washing has commenced and where some of the salt at any rate has manifestly been transferred to the sides of the drainage ditches.



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ABOUT TO BE RECLAIMED.

The amount of reclamation effected can best be judged by the increase in the area leased for agriculture.

¹The figures are:—

1898	6,917 feddans.
1899	7,578 "
1900	9,382 "
1901	12,337 "
² 1902	15,200 "
¹ 1903 estimated... ..	17,500 "

From March to December, 1902, samples of the drainage-water from the pumping station at Kassassin were examined periodically. The following are the results obtained:—

TABLE XIII.—DRAINAGE WATER.

(Parts per 100,000.)

DATE	Lab. No.	Total matter in solution.	Sodium Chloride.	Sodium Sulphate.	Sodium Carbonate.
9th March, 1902	52	116.8	45.71	25.82	Nil.
16th April, 1902	71	125.6	48.01	32.64	Nil.
1st June, 1902	107	120.0	50.39	35.68	trace.
21st June, 1902	117	131.2	59.77	40.79	"
24th August, 1902... ..	125	95.2	37.50	25.08	"
22nd September, 1902 ...	132	80.0	29.85	23.01	"
24th October, 1902	146	87.6	33.29	22.28	"
22nd November, 1902 ...	172	98.0	36.75	26.43	"
24th December, 1902 ...	188	101.2	37.89	21.56	Nil.
24th January, 1903	14	119.2	53.96	33.73	"

For purposes of comparison the accompanying table is given showing the amounts of both soluble mater and sodium chloride present in the Nile at Cairo, which differs very little from the water used for irrigation in the Wadi.

¹ Public Works Ministry Report, 1901, page 217.

² Figures supplied by the Inspector 1st Circle of Irrigation.

TABLE XIV.—NILE WATER AT CAIRO.¹

(Parts per 100,000.)

Total Matter in Solution.			Sodium Chloride.			Analyst.	REMARKS.
Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.		
20·47	13·61	16·89	2·87	0·35	1·11	Lefebvy.	One sample each month from June, 1874, to May, 1875.
29·20	12·20	18·59	6·60	0·23	2·23	Pollard.	Two samples each month from June, 1888, to May, 1889.
23·12	13·12	17·58	4·80	0·92	2·18	Droop Richmond.	One sample each month from March to September, 1891.

It will be noticed that the proportion of salts washed out of the soil by a given volume of water varies very much with the time of year, being highest when the Nile is low and gradually declining with the rise of the river and the increase in the amount of water available.

The total amount of salts removed from the land however is probably greatest from August to November, since more water being available more will be used and more washing will be done, while during the rest of the year, irrigation is the chief business and washing a secondary consideration, and it is simply the concentration and not the total amount of salts that is the greatest in the drainage-water at the time of low Nile.

The average for ten months is 107·4 parts per 100,000 parts of water, and taking 17·7 parts per 100,000 as the mean of the soluble matter in the water supplied (Table XI) there remains a total of 89·7 parts of soluble matter derived from the land for every 100,000 parts of water drained away, that is, every cubic metre of drainage water carries away 0·897 kilo. of soluble matter, the greater part of which consists of injurious salts. “Unfortunately there are no records of quantities pumped,”² and so the total amount of salt got rid of cannot be stated, nor can any estimate be formed of the actual rate at which the amelioration of the land is proceeding.

An aqueous solution of mixed salts such as the Wadi Tumilat drainage-water is constantly undergoing changes in its composition, the individual salts acting and re-acting upon one another in such a manner that at no two consecutive moments will the exact combination

¹ Contributions to the Chemistry of River water, by H. Droop Richmond.

² *Public Works Ministry Report*, 1901, p. 217.



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UNDEB RECLAMATION.



be the same, the results being dependent upon physical conditions that are always changing. Equilibrium at any given moment is conditioned by the concentration and temperature of the solution and by the amount of carbon dioxide present in the water or that can be taken up from the atmosphere.

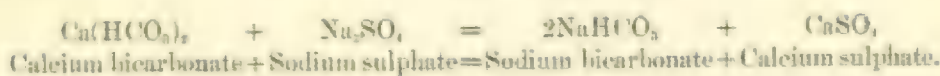
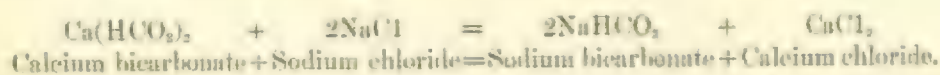
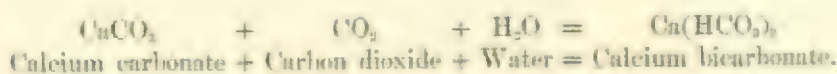
Although the drainage-water when tested never contained more than a trace of sodium carbonate and sometimes none at all yet this does not prove that no sodium carbonate whatever has been removed from the land, probably a considerable amount has been washed out, but, acting upon the calcium sulphate present it has been destroyed with the formation of sodium sulphate and calcium carbonate thus:—



A part of the sodium carbonate would also be converted into sodium bicarbonate, and as such is found in the water.

Sodium bicarbonate would probably also be formed by the action of calcium bicarbonate upon both the sodium chloride and sodium sulphate present, the calcium bicarbonate having been produced by the action of carbon dioxide upon the ordinary carbonate.

These various reactions may be represented as follows:—



Thus the sodium carbonate washed out of the soil would not be found as such in the drainage-water, while the sodium bicarbonate in the water would be far in excess of that removed from the land.

All the samples of the drainage-water contained bicarbonates in considerable quantity.

The actual amount present was determined in several cases. Calculated as sodium bicarbonate the figures are:—

TABLE XV.—BICARBONATES IN DRAINAGE-WATER.

(Parts per 100,000.)

Lab. No.	Bicarbonates calculated as Sodium Bicarbonate.
172	52.08
188	61.32
14	52.92

On evaporating to dryness a quantity of the water in order to obtain the total amount of matter in solution the bicarbonates present lose carbon dioxide and water and are converted into normal carbonates, thus the 52.08, 61.32 and 52.92 parts per 100,000 of sodium bicarbonate would be weighed in the residue after evaporation as 32.86, 38.69 and 33.12 parts per 100,000 respectively of sodium carbonate. (See also Table VIII.)

The highest amount of total soluble matter found in any one sample of the drainage-water was 131.2 parts per 100,000 parts of water.

The quantity of any given salt that water will dissolve varies with the nature of the salt and the conditions under which solution takes place, increasing as a rule with increase of temperature and increasing also when certain other salts are present at the same time, thus the solubility of calcium sulphates is much increased by the presence of sodium chloride, and that of calcium carbonate by the presence of either sodium chloride or sodium sulphate.

The following table shows the solubility of various salts when present alone in an aqueous solution:—

TABLE XVI.—PARTS DISSOLVED BY 100 PARTS OF WATER.¹

SALT.	TEMPERATURE CENTIGRADE												
	0	10	20	30	32.5	34	40	50	60	70	80	90	100
Sodium carbonate	7.1	12.6	21.4	38.4	59	—	—	—	—	—	46.1	45.7	45.4
" bicarbonate	7.9	8.8	9.8	10.8	—	—	11.7	12.7	13.6	14.4	—	—	—
" chloride	35.5	—	—	—	—	—	36.6	—	37.2	38.2	—	—	39.1
" sulphate	5.02	9.0	12.4	16.0	—	55.9	48.8	46.7	45.3	44.4	43.7	43.1	42.5

¹ "Treatise on Chemistry," Rose & Schorlemmer, Part I, vol. ii, 1887, pp. 113, 115, 130 and 131.

It will be seen therefore that the drainage water in the Wadi Tumilat is not nearly saturated with respect to any one of the injurious salts present.

From a consideration of this fact two points of practical importance arise, namely :—

First, can the same amount of work (i.e. washing the land and supplying the needs of the crops) be done with less water, or in other words, can the same amount of water be made to wash a larger area and to support more crops? and

Secondly, if water were scarce at any time or in any particular spot, would it be safe to use the drainage-water for irrigation?

With regard to the washing of the land the amount of soluble matter removed is not directly proportionate to the quantity of water used, but is more dependent upon the manner in which the water is applied, frequent washings with small quantities of water being much more efficacious than the application of more water fewer times.

So far as the supply of water for the growth of crops is concerned, while fully recognizing that on an ample supply of water in a climate such as that of Egypt, more perhaps than on anything else, depends the quantity of the produce, and that the largest crops can only be grown with a wasteful consumption of water, yet it may be stated that the tendency of the Egyptian fellah is to use too much water.

Different plants require different amounts of water, and even the same plant needs varying amounts at different periods of its growth.

¹“In the earlier stages of leafy growth when the production of vegetable tissue is proceeding with the greatest vigour, the demand for water is greatest, and luxuriant growth at this period is largely determined by the quantity of water supplied. But in the later stages of seed production, when the transference of matter rather than its new formation is the great business of the plant, the presence of an excess of water is for many plants highly injurious and greatly diminishes the proportion of seed yielded by the plant. For seed formation therefore dry conditions are desirable.”

The fellahin, however, treat all crops at all times in exactly the same manner and apply as much water as they can get.

Certainly the maximum amount of soluble matter in the Wadi Tumilat drainage-water is very low, and this must mean either that too much water is being used or that the water is not doing all the work it is capable of in removing the injurious salts from the soil.

¹“Physical Properties of Soils,” Warrington, 1880, p. 80.

Whether any injurious effects are likely to follow the application of the drainage-water to the land as an exceptional measure in any special locality and for a limited period, would largely be conditioned by the efficiency of the drainage. The great danger would be the formation of the very harmful sodium carbonate, in places where it did not previously exist, by the separation of sodium bicarbonate from the solution and its subsequent conversion into carbonate.

In the Wadi Tumilat at least four different forces are constantly operative for evil, and it is against these that any reclamation work to be successful must make headway.

The evils are:—

(1) The constant seepage from the Ismailia Canal and its branches, with its attendant dangers of excessive sub-irrigation and the rise of salt from the subsoil towards the surface. That this seepage is really taking place at the present time is shown in Plate XV in which the efflorescent salts that have been brought to the surface by the rise of the seepage water are clearly marked.

(2) The descent from the higher desert lands on either side of injurious salts already present and likely to be brought down by every rain.

(3) The carrying by the wind of the efflorescent salts from the unreclaimed area and from the desert over the cultivated land.

(4) Sand encroachment.

To counteract the seepage from the canal and the drainage of injurious salts from the higher levels the remedies are the judicious use of irrigation water, deep drains and plenty of them.

Economy in the use of water is of vital importance in any region where injurious salts exist in excess in the soil, for two reasons:—

First, that there is great danger of the salts being brought to the surface or within reach of the roots of the crops by the rise of the level of the subsoil water, and

Secondly, that water applied to the land on a high level in excess of that required by the crops will drain on the lower lands carrying with it a large amount of harmful material.

This is very marked in the Fayum where the land slopes down towards the north-west from Medineh 22·5 metres above mean sea-level to Lake Qarun about 44 metres below mean sea-level.

“Throughout the Fayum the low lands are invariably sacrificed to the high. The level of the areas covered by efflorescences and of those places where the soil is either too bad to admit of any cultivation at



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BANK OF THE ISMAILIA CANAL.

all or else gives only the poorest of crops, is generally below that of the surrounding fields, and it is the drainage from the adjacent and higher ground, carrying with it an excess of injurious salts, that by percolating on the lower ground is the cause of the injury. Over-irrigation without corresponding drainage accentuates the evil. Every excess of water used for irrigating the higher lands beyond that actually required for the growth of the crops injuriously affects the lower lands."¹

Good drainage, however, is the one remedy for all alkali lands.

The only method of preventing the efflorescences from being carried by the wind and distributed over the cultivated land is to reclaim as speedily as possible the present uncultivated areas.

With regard to sand encroachment, nothing can entirely prevent it, but with care the evil may be kept within narrow limits. Fences and the growth of perennial plants with widely spreading roots will do much to check the progress of sand.

GENERAL CONSIDERATIONS.

The manner in which the Wadi Tumilat was ruined is typical of the way in which other relatively low-lying lands in Egypt are also being ruined, though perhaps not on so large a scale, as, for example, in some parts of the Fayum.

Whenever a district is irrigated from a high-level canal without adequate provision being made for efficient drainage, invariably the low-lying fields will be converted into swamps, the general level of the subsoil water will be raised and the injurious salts will be brought to the surface.

"A good deal of injury has resulted to the low lands in the Fayum from the cultivation of the higher lands bordering the desert, as in many places these lands can be irrigated only by making channels in embankment across high ground, and in order to get the water on to the high ground a high level is maintained both in these channels and in the main canals which feed them."²

The Wadi Tumilat may serve also as a type of the only way in which alkali lands can be reclaimed. There is but one remedy, and on the extent of the application of this depends the degree of fertility to which the land will ultimately be restored. The remedy consists

¹ "A Preliminary Investigation of the Soil and Water of the Fayum Province," Survey Department, P. W. M. Egypt, p. 12.

² Report on the Administration of the Irrigation Department, 1895.

of thorough drainage and frequent washing. Drainage alone is insufficient, and washing without drainage is useless.

As supplementary aids to the restoration of the land to a satisfactory condition of fertility may be mentioned the special treatment by chemical or other means of those parts where sodium carbonate is known to occur in excess, and the cultivation in the first instance of plants that show a high degree of resistance to the particular injurious salts that are found to be present.

The chemical amelioration of alkali lands consists in the application of gypsum as described on page 387 ; other means are the addition and ploughing in of sand, carbonate of lime or lime. These methods are purely physical and act by making the clay more friable, more pervious to water, and hence more easily washed free from harmful salts.

In the reclamation of alkali lands, as in many other matters, much can be accomplished by rule-of-thumb methods aided by experience, but to obtain the best results in the shortest time and at the smallest cost the problem must be studied and solved on scientific lines.

A. LUCAS.

REPORT ON THE TECHNICAL DEPARTMENT

1902

BY

MD. ANIS BEY,

CHIEF OF TECHNICAL DEPARTMENT.

TECHNICAL DEPARTMENT.

YEARLY REPORT, 1902.

The work of this Service under the regulations issued in November 1900 continues to be very satisfactory. Steam Engine Service.

Very few cases were referred to the Contentieux for opinion during the year and they were easily settled to the satisfaction of the Service.

There was one case, however, on which Mr. Crawley and Mr. De Rocca Serra had a difference of opinion.

In a letter sent in answer to a question submitted to the Contentieux by Mr. Crawley, during my absence on leave last summer, Mr. De Rocca Serra stated that the Steam Engine Service had no right to ask an engine owner to stop his engine and remove the masonry covering off his boiler, and therefore necessitate the closing of his establishment for sometime, just for the sake of inspecting the engine, so far as that owner was in order as far as his Rokhsa or his declaration is concerned, and that the paragraph in art. 4 referred to by Mr. Crawley in which it is said "La chaudière ne devra être maçonnée ni couverte avant les épreuves" was only applicable to new installations and not to those already established.

The question was referred to me soon after my return and I had a consultation with Mr. De Rocca Serra on the subject. I discussed with him not only art. 4 but also art. 6 in which it is plainly stated that the renewal of test was to be carried out under the conditions of art. 6. I also showed him the correspondence between the Mixed Court and this Ministry at the time the new law was being promulgated.

During this discussion I found Mr. De Rocca Serra was right in forming his opinion on the sense he understood the question, but after explaining to him the Technical difference between hydraulic test and ordinary inspection and showing him that the demolition of the masonry was generally required in the former case and very seldom in the latter, the matter was finally settled to the satisfaction of the Service, with the understanding that this vast power should be used with the greatest caution and only in cases of absolute necessity.

Another question of minor importance concerning the Industry Rokhsas which are granted from the Ministry of the Interior, was also easily settled.

It is now agreed that before the Service grants a Rokhsa for a steam engine it should ascertain that the Mudirieh or the Governorate has no objection to authorize the industry.

Thus far the work has been carried out during the year much more independently than even the year before.

The number of applications for Rokhsas received during the year 1902 was 290 as against 323 in 1901 (the first year of the regulations).

This together with 66 remaining under consideration from the year before, and 27 received from the Mudiriehs for using irrigation pumping engines also for industrial purposes, makes a total of 383.

Of this number 319, including the 27 from the Mudiriehs, were granted and 64 remain under consideration.

Of the 319 engines receiving Rokhsas, 187 were examined and tested, and proving satisfactory were allowed to work.

This number together with 869 sanctioned for work up to the end of the year 1901 makes a total of 1,056 industrial engines working in conformity with the law up to the end of November 1902.

The work of inspecting and reporting on old, declared or undeclared engines is still vigorously carried out. 613 such visits of inspection were made during the year, these with 187 visits made for testing the engines sanctioned during the year, make the total number of inspections 800.

Besides the above, the Service was called upon on several occasions to examine or test old irrigation pumping engines complained of as being dangerous or in very bad repair. Some of these engines were found in such a dangerous state that the Service was obliged to stop them administratively after obtaining the consent of the Irrigation Service.

The 2nd Circle of Irrigation also sent a list of about 70 engines for examination which will be taken in hand in 1903.

I have here to remark that art. 6 of the Decree empowers the Steam Engine Service to examine and inspect all irrigation engines, and to prescribe to them any conditions that it may deem necessary for the public safety.

In dealing, however, with these irrigation engines the state of the crops has to be carefully considered in order not to cause any unnecessary loss to the owners, the irrigation inspectors are therefore invariably referred to before any serious steps are taken to stop, or even to temporarily arrest, the working of such engines.

As regards contraventions we have so far been successful, nearly all cases have been gained especially those brought up for overloading safety valves and working overpressure.

The assistant inspectors who, in virtue of the Decree issued on the 13th of April 1901, were given the right to appear before the Courts as Police Judiciaire, were often called upon to give evidence on the cases they had laid.

36 engine owners were prosecuted during the year, 27 before the native Courts and 9 before the Mixed Tribunals.

In the Native Courts 2 were sentenced to stop their engines, 8 were fined, 5 paid fines at the Parquet without going to Court, and 12 are still in Court.

In the Mixed Tribunals, one was sentenced to stop his engine, 3 were fined, 2 were acquitted, and 3 are still in Court.

Two irrigation engine boilers exploded during the year, one belonged to a native and the other to a Greek.

The first occurred on the 10th of June at Kafr-il-Shorafa, Menufieh Province. The cause was attributed to overpressure and great corrosion by negligence and old age.

From the report made by the Inspector and submitted to the Parquet directly after the accident, it appears that the boiler at the time it exploded carried from 80 to 90 lbs pressure per square inch, its original working pressure being only 60 lbs. The plates at the seating when examined were found so thin from corrosion that in some places they were no thicker than a piece of paper.

Two persons were unfortunately killed by this accident.

The other boiler was at Mustroil, near Matarieh. The cause was almost the same as the above.

Happily no loss of life attended this accident.

Great praise is due to Mr. Crawley (who still acts as Inspector of Steam Engines) and his staff for the manner in which they have carried out their work during the year with such satisfactory results.

39 Rokhsas for irrigation fixed engines were given from the Technical Service during the year.

Irrigation
fixed engines.

The fees received from these Rokhsas came to £E.350. The total number of Rokhsas at the end of 1901 was 789. Of these, 12 are cancelled and 777 remain. This number with the 39 new Rokhsas, make the total number of Rokhsas in hand 816.

Their distribution among the different irrigation Circles is as follows:

	Cancelled in 1902	Given in 1902	In hand to end of 1901	In hand to end of 1902
1st Circle	5	15	216	226
2nd Circle	6	17	309	320
3rd Circle	0	3	102	105
4th Circle	0	0	130	130
5th Circle	0	1	23	24
Guirga Directorate ...	1	0	9	8
Delta Barrage Dte. ...	0	3	0	3
	12	39	789	816

Quarries
service.

The number of Rokhsas for quarries, in Cairo and its vicinity, given by this Service to the end of 1901 was 627. 132 of the old system given for life and 495 given for a term of ten years.

Of these, 49 are cancelled, 6 from the former (5 by exchange and 1 by the death of the owner) and 43 from the latter (40 by expiration of time, 2 by exchange and 1 for contravention).

The number of new Rokhsas given this year is 35, and the total number now in hand will thus be:—

Old Rokhsas given for life (132-6)	= 126
New Rokhsas given for 10 years (495-43+35)	= 487
Total... ..	<u>613</u>

The different localities of these quarries and their time of expiry are shown in the table on page 409.

I.—ARTICLES PURCHASED OR MADE.

Central Stores.

(A) *Instruments and camp equipments.*

		£E.	Mill.	
Purchased from Europe	England	451	135	
	France	33	875	
				485 010
Made by Govt. Services	War Office (tents)...	67	595	
	Sanitary Dept. ...	56	605	
	Arsenal	125	305	
				249 505
Purchased in Egypt..	... ..	215	478	
				949 993

(B) *Furniture.*

		£E.	Mill.	
Furniture made at the Arsenal.	... ..	56	330	
" purchased in Egypt..	... ..	231	441	
				287 771
				1,237 764

II.—REPAIRS TO INSTRUMENTS.

		£E.	Mill.	
Repairs made at the Arsenal.	... ..	338	359	
				1,576 123

III.—ARTICLES SOLD.

		£E.	Mill.	
To the Projects Circle	... ..	23	403	
To the Arsenal (articles out of use).	... ..	1	153	
To Mr. J. L. Baird	... ..	15	500	
				40 056

IV.—ORDERS GIVEN TO THE STORES.

		£E.	Mill.	
For issue of articles	to Government Services...	241	—	
	sold.	7	—	
				248 —
For receipt of articles..	returned	131	—	
	purchased	67	—	
				198 —

The value of the articles delivered from the stores was £E.1,791.025 distributed as follows:—

	£E.	Mill.
Irrigation Department...	555	831
Building and Tanzim ...	514	943
Administrative Service ..	290	337
Technical Service...	52	213
Antiquity Service...	21	000
Survey Department (tents)...	110	190
Reservoirs Service..	306	511
Total	£E.1,791	025

Arsenal and
Boats.

The value of the work executed in the Arsenal workshops, and the materials delivered from its stores during the year 1902 amounted to £E.28,057 as against £E.30,474 in the year before.

Most of this amount or nearly 89 % of it was charged to the different branches of the Ministry of Public Works, the rest or about 11 % was charged to other Government Departments and private individuals, shown as follows:—

	1902	1901
	£E.	£E.
Value of work executed for P. W. D.	22,504	24,278
" " other Government Departments.	2,966	3,313
" " Private individuals	139	305
Total value of work... ..	25,609	27,796
Value of coals and Engine room stores for steamers	2,748	2,673
Grand total... ..	28,357	30,474

The distribution of the first two items above is shown as follows:—

Sum charged to the different branches of the Ministry of Public Works.

	1902	1901
	£E.	£E.
Irrigation Services..	15,328	15,176
Reservoir Service	143	528
Building and Tuzim	671	2,721
Survey Department	1,646	796
Administrative and other Services	370	534
Repairs to steamers and maintenance of Arsenal plant	4,343	4,123
Total... ..	22,504	24,278

Sum charged to the other Government Departments.

	£E.
Ministry of Justice	325
" Finance.	245
" Interior.	211
" Public Instruction	111
Wakf Administration	19
Sanitary Service	928
Army of Occupation	55
Khedivial Yachts	107
Mudiriks, Governorates and Town Councils.	405
Model workshop	560
Total... ..	£E.2,966

The main items in the charge against the Irrigation Circles were for:—

671 tons of steel pipes costing £E.8,232 as against 516.5 tons at £E.8,131 in the year before.

163 tons of Cast Iron Grooves costing £E.1,766.

3680 Piece of regulating sleepers at E. £E.2,720.

Besides £E 668 for building dredger and erecting its machinery and £E.2,710 for miscellaneous work and stores.

The rate of cost of the steel pipes in 1902 came to £E.12.27 per ton as against £E.15.70 the year before. This reduction, which is about 21.8 %, was due to the lower price paid for materials and also to the reduced cost of labour by the use of machines. Steel plates were bought at the average price of £E.8.0 per ton and coals at £E.1.350 per ton while the lowest prices paid for them in 1901 were £E.8.5 and £E.1.600 per ton respectively. Again, most of the pipes being this year of large size, from 1.50 to 2.00 metres diameter, they were almost entirely made by the hydraulic and steam machinery bought for the Arsenal in 1901 and the cost of labour was thus considerably reduced, the rate coming to £E.1.49 in 1902 as against £E.2.03 per ton in 1901, the economy being £E.0.54 per ton or £E.362 on the quantity of pipes, alone, supplied during the year.

The quantity of work executed for the Building and Tanzim Service this year was rather small compared with previous years on account of the transfer of the Scavenging Service to the Sanitary Department. This work consisted as usual of making and repairing carts.

The Survey Department was supplied mainly with iron triangulation marks, technical apparatus, office furniture and fittings, and sundry other work.

The other Services in the Ministry were as usual supplied with office furniture, instrument repairs and fittings, etc. Very little was done to the Arsenal workshops this year.

The machines were increased by only a small portable hydraulic rivetter, a force pump, and a small centrifugal fan, the shop engine and some of the machine tools were repaired, part of the stores was altered, and some of the walls put in order. This cost £E.525.

Besides the above, the sum of £E.319 was paid for small hand tools and sundry other expenses, including £E.61 for precautions against cholera. Thus the total expenditure on the maintenance of the Workshops came to £E.844 which was paid from the Arsenal profits.

Of the floating plant, the dredger and some of the rowing boats, also a barge and a house boat were repaired, the crane on the river bank was adjusted, some awnings were made, and a wooden railing was erected along the Nile bank, the whole work costing £E.303.

The cost of materials bought for the Arsenal stores this year amounted to £E.15,982; of this amount, materials to the value of £E.13,623 were taken from local merchants and £E.2,359 ordered direct from Europe.

The quantity issued from the stores to the workshops amounted in value to L.E.15,465 and to the steamers for canteen and deck stores to £E.704.

Besides the above, iron and brass castings to the amount of £E.2,481 were turned out from the foundry and received in store. Of this amount, castings to the value of £E.1,928 were issued and delivered to different clients, the remainder, to the value of £E.553, being still in stock. Materials for this quantity of castings cost £E.1,520 and labour £E.961.

The total cost of labour in the workshops, exclusive of foundry came to £E.5,083 during the year.

The new machine tools introduced last year have further reduced the rate of labour on iron work, as I have stated when speaking on the work supplied to the Irrigation Circles; here I will merely show the comparison of the rates per ton in the last four years.

											Rate of labour per ton of steel pipes.
Year 1899...	...	...	...	...	...	...	...	...	...	...	2.48
" 1900...	...	...	...	...	...	...	...	...	...	...	2.41
" 1901...	...	...	...	...	...	...	...	...	...	...	2.03
" 1902...	...	...	...	...	...	...	...	...	...	...	1.49

The Arsenal has, in my opinion, reached the limit of economy of labour on this kind of work and any further reduction of the cost must be looked for from the prices of materials. But under the present Financial arrangement, and from the way orders are received for the supply of work, not much can be hoped for in the way of economy from this direction. By the Financial rules the Arsenal is not allowed to lay in a stock of materials unless paid for from its budget, consequently materials have to be got for nearly every separate order after it is received, and if the order be at all urgent it necessitates going to the nearest market and paying local prices which are nearly always high. But, if sufficient time is allowed before delivery is required, the Service can then order its materials from Europe, either direct or through local agents, at suitable prices. This however is not often the case, for most of the orders received, especially from the irrigation circles, are required to be executed in a limited time to suit the state of the river, and moreover the work being of the same nature all the circle, at least the two or three of them that patronize the Arsenal, send in their documents at the same time and also require their work to be

delivered at about the same time. The consequence of this is that the workshops are full of work required in a hurry during a certain part of the year and almost have nothing to do during the other part. In the former case the Service has not only the difficulty of getting the materials required, but also of procuring labour, and in the latter it has to dismiss most of its men and have all its monthly paid hands idling about practically doing nothing.

To ameliorate this condition to a certain extent, I have asked some of the inspectors to try and give a part of their orders a little earlier, in anticipation of what may be required, so that even if a part of it was found not to be required during the year it could be kept in stock in the Arsenal under their demand for the following year. This arrangement would enable the Service, on the strength of having the order, to buy the materials in good time at suitable prices, and also have time to execute the work without undue hurry. Mr. Tottenham of the 2nd Circle has already acted upon this arrangement and I have every hope that it may prove to his convenience.

Before high Nile every steamer was thoroughly overhauled and repaired or furnished as required.

The *Messir* which was taken in hand for extensive repairs late in November 1901 was finished in time to go to Aswan for the inauguration of the Reservoirs. Soon after the dismantling work on this steamer was commenced it was found that the repairs required would prove more extensive than was at first anticipated.

Her hull was found to be in a far worse condition than was expected, and all the wood work was found to be unfit for any further use.

It was then decided to dismantle her altogether, redesign and reconstruct her forward and aft saloons and cabins, doing away with the poop and substituting for it an upper deck running the whole length of the boat with a dining saloon built on its after part.

The boat can now accommodate 12 persons very comfortably and even 15 if desired.

The total cost of repairs and deck fittings and stores to the steamers amounted to £E.3,025.5, the cost of coals and engine room stores to £E.2,748.5, and the expenses of the crew to £E.2,137.5. Thus the total expenses on the boats amounted to £E.7,811.5, shown in detail as follows:—

STEAMERS	Repairs.		Dock Stores.		Coals, Oils, &c.		Crew.		Total.	
	£E.	MILL.	£E.	MILL.	£E.	MILL.	£E.	MILL.	£E.	MILL.
Nasratieh	60	099	59	780	399	613	351	457	870	949
Messir... ..	1,805	094	373	326	280	196	59	924	2,518	540
Tahta	58	484	26	764	192	851	274	420	552	522
Kahira	37	844	31	619	169	170	116	004	354	637
Boulaq	28	407	—	—	294	432	216	750	539	589
Refik	73	307	35	859	99	649	122	051	330	866
Dendera	63	644	50	823	647	822	209	803	972	092
Rekih... ..	70	087	70	117	101	635	209	166	451	005
Tawaf	23	438	21	547	76	951	147	364	269	300
No. 1	21	525	10	545	230	969	157	554	420	593
Moeris	10	355	20	437	126	501	64	184	221	477
No. 74... ..	3	508	0	453	64	298	58	808	127	067
No. 25... ..	43	661	2	888	55	277	99	000	200	826
Dredger	21	950	—	—	9	143	51	000	82	093
Total... ..	2,321	403	704	158	2,748	510	2,137	485	7,911	556

Of this total expenditure £E.6,197 were paid from the ordinary Budget, £E.518 from the Arsenal profits, and £E.1,196 were received for expenses of steamers lent.

Mr. Curtis conducted the work of the Arsenal during the year with his usual energy and ability, and I have here only to repeat what I have said of him in my previous reports.

M. ANIS.

Chief of Technical Department.

Cairo, 6 April 1903.

QUARRIES SERVICE.

YEAR OF EXPIRY OF ROKHSAS.

LOCALITY.	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1920	Reliquous for life.	Total.
<i>I.—Stone and basalt quarries.</i>													
Helwan	8	9	11	5	4	10	3	6	6	3	—	1	66
Ma'sara (el)	14	3	2	5	—	4	5	4	4	1	—	3	45
Tura	1	7	1	3	5	—	2	—	1	1	—	29	50
Hashmy (el)	—	—	—	—	2	—	—	—	—	—	—	5	7
Messan (el)	—	1	—	—	—	1	—	—	—	—	—	1	2
Eyoun Mousa	8	3	4	2	—	3	2	—	—	—	—	12	31
Harif (el)	—	—	—	—	—	—	—	1	1	1	—	—	3
Rmaza (el)	1	—	7	8	7	6	3	4	1	1	—	6	44
Motablak (el)	—	1	—	—	—	—	1	—	—	—	—	2	4
Tahlita (el)	4	1	1	1	—	—	—	—	—	—	—	—	7
Bassatin (el)	—	—	2	—	—	1	—	2	—	—	—	—	5
Atar-el-Nobi	9	9	—	—	5	5	2	—	9	3	—	4	43
Rato-el-Bakara	7	4	—	3	3	3	3	5	2	2	—	11	43
Ein-el-Sira	—	1	2	—	5	2	3	—	—	—	—	8	21
Abul Seoud	—	1	1	—	1	—	—	—	—	2	—	9	11
Zawlat Nagra	2	4	—	2	3	8	10	2	7	2	—	8	48
Abiad (el)	1	1	—	—	6	5	—	—	4	—	—	83	254
Ma'dassa (el)	1	2	—	3	1	8	—	2	2	2	—	113	321
Devaika	2	1	—	1	3	1	3	4	4	—	—	4	23
Ahnar (el)	1	—	4	18	10	4	2	3	—	1	—	3	46
Abbassieh	—	—	—	—	—	—	—	—	1	—	—	—	1
Khneih (el)	—	—	—	—	—	—	—	—	—	—	—	1	1
<i>II.—Pebble, stone and sand quarries.</i>													
Bab-el-Nasr	—	—	—	—	—	—	—	—	—	—	—	—	—
Bassatin (el)	—	—	—	—	—	—	—	—	1	—	—	—	1
Abbassieh	7	4	2	1	4	—	9	8	6	6	—	—	47
<i>III.—Gathering of gypsum.</i>													
Helwan to Bayed Bey, Rameses.	—	2	—	—	—	—	—	—	—	—	—	—	2
<i>IV.—Extraction of clay.</i>													
Ma'ssara (el)	—	—	—	—	—	—	—	—	—	—	4	—	4
Total	66	54	34	52	59	61	48	41	46	25	1	126	613

RAPPORT DU SERVICE DES ANTIQUITÉS

POUR L'EXERCICE 1902

PAR

G. MASPERO

DIRECTEUR GÉNÉRAL

RAPPORT DU SERVICE DES ANTIQUITÉS

I. — SERVICE ADMINISTRATIF.

L'augmentation totale de notre budget régulier a été pour l'exercice 1902 de L.E. 770, dont — pour nos frais d'inspection et de déplacement. Malgré cette augmentation, ces frais ont dépassé le chiffre prévu de L.E. 345, qui ont dû être prélevées sur les divers fonds du Service. Il est à craindre qu'ils ne cessent de s'accroître pendant quelques années encore, à mesure que la surveillance s'étendra plus stricte, non plus seulement sur les sites célèbres, les seuls que nous gardions autrefois, mais sur les sites secondaires que les marchands d'antiquités exploitaient presque impunément dans ces derniers temps. Pour établir la surveillance sur les points menacés et pour l'y maintenir efficace, les inspecteurs généraux multiplient les voyages dans tous les coins du pays et ils incitent les inspecteurs locaux à circuler sans relâche dans les limites de leurs provinces. D'autre part, les règlements sur le *sebakh* et sur les *chakfs*, dont l'application, tandis qu'elle se régularise, soulève certaines difficultés dans plus d'une localité qui exigent de la part de notre personnel des allées et venues continuelles, tant pour la concession des sites et pour la vente des matériaux que pour le choix des *ghafirs* provisoires et pour la prise de possession des antiquités découvertes au cours des opérations : les résultats ne commencent à s'en faire sentir heureusement que grâce à la fréquence des tournées d'inspection. Toute cette activité, qui je l'espère, ira se développant de plus en plus, entraîne de grosses dépenses que notre budget éprouve déjà quelque peine à supporter et qui deviendront toujours plus lourdes, quelque parcimonie que nous mettions dans l'emploi de nos frais de déplacement.

Inspection du Directeur général. — Elle n'a duré que deux mois, du 5 décembre 1901 au 4 février 1902, et elle a confirmé l'impression que j'avais rapporté des inspections précédentes sur l'état des monuments. Les dégradations qu'ils subissent malgré nos soins sont dues souvent à des causes accidentelles dont il est difficile, si non impossible, de prévenir l'action : ainsi à Béni-Hassan, un orage violent avait rempli d'eau les tombes, pendant la nuit du 10 au 11 décembre, et gâté

le bas de quelques tableaux : à El-Amarna, une dame de nationalité américaine, a démolì à coups d'ombrelle, en mars 1902, un coin du pavement peint découvert par M. Pétrie, avant que le ghafr eût le temps d'intervenir, non plus que les deux voyageurs européens qui m'ont signalé le fait ; à El-Kab, le séil du 1^{er} janvier 1902, a enlevé quelques-uns des blocs de la jetée antique qui protégeait la ville du côté sud ; dans plusieurs tombeaux de rois Thébains, notamment dans celui de Sêti 1^{er}, la trépidation produite dans le sol des galeries et des chambres par le piétinement des bandes de touristes, se propage de temps en temps aux parois et aux plafonds dont elle a fait tomber des parties plus ou moins considérables cet hiver, un fragment de voûte et un pilier. Très souvent aussi le mal a des causes qu'il eût été possible d'atténuer ou parfois même de supprimer si on l'eût attaqué dès le début : ainsi à Kom Ombo, au moment où l'on déblayait l'aire du temple, on eût pu baisser d'un tiers ou de moitié la hauteur d'une partie de la butte et en alléger le poids jusqu'à le rendre peu dangereux, au lieu qu'on a essayé de contenir le sable et les décombres au moyen d'un simple mur en briques sèches élevé sur les restes de l'enceinte antique de pierre. Pendant l'inspection de cette année, je me suis efforcé de noter dans chaque localité les points où le péril paraissait être le plus pressant, et j'y ai fait exécuter les travaux les plus indispensables autant que les ressources du budget me le permettaient. Dans le temple de Sêti 1^{er} à Abidos et dans celui de Ramsès III à Karnak, une partie des architraves et des dalles dont le toit se compose, ont pu être consolidées de poutrelles en fer sur les indications que j'avais fournies à la suite de l'inspection de 1901 ; mais parfois, nous sommes arrivés trop tard pour empêcher l'accident ; au petit temple de Thoutmôsis III, à Médinet-Habou, deux des poutres de grès du sanctuaire se sont abattues le 8 décembre 1902, mais c'est à Kom Ombo que le mal a été le plus grave. J'avais, dans les premiers jours de janvier, donné l'ordre d'enlever les masses de sable qui pesaient sur la face Est de l'enceinte, mais les travaux n'ont pu être menés assez vite, manque d'argent, et nous n'avions baissé que de trois mètres environ le niveau de la butte lorsqu'en mai dernier, le mur de briques a cédé brusquement vers l'endroit où les figures de l'empereur Macrin et de son fils Diaduménien sont gravées : un torrent de sable s'est répandu dans le couloir, disloquant une vingtaine de blocs du mur ancien. M. Carter a enlevé le sable aussitôt, puis il a étagé le mur de pierre avec des poutres et il a jeté autant de décombres au Nil que nos ressources le permettaient, mais le danger n'est pas conjuré encore. Nous reprendrons le déblaiement en 1903, et s'il le faut nous raserons

sinon la butte entière au moins les parties de la butte qui surplombent les ruines du temple vers l'Est et vers le Sud.

J'espère que nous éviterons à Edfou un malheur plus grand encore à celui qui a frappé Kom Ombo. En examinant la position du mur d'enceinte en pierre qui borne le temple à l'Ouest, j'avais cru remarquer que les fondations en avaient fléchi sensiblement depuis l'an dernier : il m'avait semblé également que la crête du mur s'était inclinée un peu plus vers l'intérieur et surplombait la ligne de base d'une quantité plus considérable. L'inspecteur d'Edfou, Mahmoud Effendi Mohammed, que j'avais chargé d'observer journallement cette partie du temple, nota les mêmes faits que j'avais relevés déjà : en repassant sur les lieux, le 7 décembre dernier je me suis convaincu que le mal avait fait de grands progrès dans les dix derniers mois et qu'il convenait d'intervenir énergiquement pour l'enrayer. J'expédiai à Edfou M. Barsanti alors en mission dans l'île de Philae, avec ordre de rechercher ce qu'il en coûterait pour démolir les parties dangereuses de l'enceinte pour y faire des fondations nouvelles, puis pour les reconstruire d'aplomb. Dès le 12 décembre, M. Barsanti qui s'était fait accompagner de notre maître maçon indigène, m'informait que la partie du mur que je l'avais envoyé examiner surplombait la base de 0^m 59 en son point le plus dangereux et qu'il serait nécessaire de la démolir entièrement sur une longueur de 70 mètres environ de l'angle Nord-Ouest, à la porte qui donne sur la colonnade Ouest de la Cour d'honneur ; il ajoutait que les cinq colonnes les plus septentrionales de cette colonnade étaient fort endommagées ainsi que la portion attenant au mur, et qu'elles réclamaient une réparation prompte. Il estimait qu'une somme de L. E. 1,200 suffirait pour restaurer solidement le mur, et qu'il faudrait consacrer environ L. E. 400 à la restauration des colonnes. Les économies que nous avons réalisées sur les travaux de Philae nous ont permis de faire face à cette dépense imprévue sans demander de crédits nouveaux. Le Ministère des Travaux Publics nous a autorisés à prélever sur elles une somme de L. E. 1,000 qui serait appliquée à Edfou. M. Barsanti s'occupe de rassembler les bois et les machines nécessaires : j'estime qu'il pourra commencer les travaux en mars 1903 et qu'à la fin d'octobre de la même année il aura terminé la reconstruction du mur : la réfection des colonnes ne se fera probablement pas avant l'année 1905.

Travaux des inspecteurs en chef. — Les deux grandes provinces entre lesquelles l'Égypte est divisée en ce qui concerne les travaux des antiquités présentent des caractères assez différents pour que chacun des deux inspecteurs en chef ait été obligé de donner à son activité une tournure particulière.

1^{re} Inspection du Sud. — Dans l'inspectorat du Sud, de Nag-Hammadi à la seconde cataracte, les terrains de culture sont généralement assez restreints et la population est peu dense depuis l'époque romaine. Les sites antiques ont donc relativement peu souffert et les temples complets ou les restes considérables de temples et de villes sont fréquents sur les deux rives du fleuve ; ce n'est que dans la partie méridionale de la moudirieh de Kéneh que, la plaine s'élargissant, les cultures se sont développées depuis une quinzaine d'années et que la vie moderne tend à empiéter de plus en plus sur ce qui avait été jusqu'à présent le domaine presque exclusif de la vie antique. Les questions d'usurpation de terrains et des prises du sébakh ne jouent qu'un rôle secondaire dans les préoccupations de M. Carter ; sur deux points seulement il rencontre des difficultés sérieuses ; à Karnak où la population du village dit Naga-Zaptieh ne cesse de gagner sur le champ des ruines et ne peut être contenue qu'au prix d'efforts continus ; à Haou, dans le markaz de Nag Hammadi, où un gros propriétaire du voisinage, Khalafallah Bey, a essayé indûment de s'approprier les buttes de sébakh où toute la région s'approvisionne. Un procès engagé à ce sujet depuis le milieu de l'année 1901 est pendant encore devant le tribunal de Kéneh, malgré nos efforts pour le faire aboutir : l'issue en est attendue par la population avec une certaine anxiété, car au cas où Khalafallah Bey l'emporterait, elle devrait acheter au nouveau propriétaire à des conditions fort onéreuses le sébakh que nous lui livrons gratuitement, sans rien exiger d'elle que la solde de deux ou trois ghatirs provisoires. Partout ailleurs, M. Carter n'a guère qu'à s'inquiéter de la conservation et de la police des monuments, ce qu'il a fait cette année avec le même zèle que les années précédentes. C'est ainsi qu'il a surveillé, à Edfou, la pose des poutres de fer destinées à consolider la couverture du pronaos et de la salle hypostyle ; à Kom Ombo, l'enlèvement des sables et l'étangonnage des portions menacées du mur d'enceinte en pierre ; à Thèbes la pose de portes en bois à plusieurs des tombeaux du cheikh Abdel Gournah et l'installation de la lumière électrique dans six des hypogées de la Vallée des Rois.

Dès mon retour en Egypte, j'avais été frappé des dommages que les hypogées royaux avaient subi durant mon absence, du fait des torches et des bougies dont les voyageurs s'éclairaient pour les visiter. Après avoir songé un moment à l'acétylène, je m'étais arrêté à l'idée d'employer la lumière électrique. L'usine où la force électrique serait produite devait être établie dans la vallée même et un réseau de fils métalliques la transporterait dans les tombes choisies pour l'essai : les difficultés matérielles n'étaient pas minces, mais l'obstacle principal à la réalisation

de ce projet était le manque d'argent. Je réussis pourtant à économiser 400 L. E. sur le fonds des touristes au cours de l'année 1901 et, muni de l'autorisation ministérielle, je décidai de tenter l'aventure en 1902. Je passai un contrat avec M. Zimmermann, ingénieur électricien établi à Louxor pour le compte des hôtels de M. Pagnon : il s'engageait pour la somme de L. E. 560, à nous fournir une machine à pétrole Crosslay de la force de quinze chevaux, à l'établir à l'endroit que nous lui indiquions, à poser le réseau et les lampes dans six tombes à notre choix le tout dans un délai qui ne devait pas dépasser trois mois. Tout bien considéré, il fut convenu avec M. Carter que l'on approprierait aux besoins de l'usine la tombe la plus voisine de l'hypogée de Sétî I^{er}, celle de Ramsès XI Khopirmari, dont les sculptures étaient presque entièrement détruites : l'entrée et le vestibule en furent déblayés, murés, couverts à nos frais, du 2 au 15 janvier 1902, puis livrés à M. Zimmermann qui se mit à l'œuvre le 17. L'ensemble du travail fut terminé le 22 mars, et reçu quelques jours plus tard par M. Jacot des Combes, chef du service d'électricité au Ministère des Travaux Publics. La dépense totale s'élevait à L. E. 649,092 ainsi réparties :

	L. E.	Mill.
Adoption du tombeau N° 18 et transport du matériel de la gare de Louxor aux Bilan-el-Melonk	58	292
1 machine motrice horizontale à pétrole de la force nominale de 15 ch. 180 révol. et de 17 ch. effectifs	235	000
1 dynamo de la puissance de 60 Ampères : 110 Volts, 1270 révolutions	56	000
1 tableau complet avec ampèremètre, voltmètre, interrupteur, etc.	9	000
2 réservoirs pour l'eau froide	19	000
99 lampes fournies et posées	100	000
Câbles, fils, isolateurs	100	000
Pose des fils et dépenses diverses	41	000
Surveillance des travaux	31	920
	650	212
d'où il faut retrancher la taxe	1	120
Total... ..	649	092

Environ 1,000 mètres de câbles et de fils furent posés, les câbles installés à l'extérieur circulant sous terre sauf aux points où il fallait passer d'un côté à l'autre de la vallée.

Les tombeaux éclairés sont les suivants :

	Lampes de 10 bougies.	Lampes de 16 bougies.	Lampes de 32 bougies.
Tombeau d'Amenôthès II (N° 35)	—	15	12
Tombeau de Ramsès I ^{er} (N° 16)	—	7	—
Tombeau de Sétî I ^{er} (N° 17)	—	31	2
Tombeau de Ramsès III (N° 11)	8	10	—
Tombeau de Ramsès VI (N° 9)	—	4	—
Tombeau de Ramsès IX (N° 6)	—	10	—

Avant d'établir le réseau M. Carter eut le soin, ainsi qu'il en avait reçu l'ordre, de les mettre dans un état aussi satisfaisant que possible. Toutes les crevasses qu'on y voyait ont été bouchées et les blocs du plafond soutenus lorsqu'ils paraissaient menaçants pour la sécurité des visiteurs. Des escaliers ou des plans inclinés en bois ont été établis dans les portières des tombes N° 6, N° 9, et N° 35 qui présentaient des marches usées ou des plans inclinés glissants. Des murs bas ont été bâtis à l'entrée de toutes les tombes pour prévenir l'invasion du sable et des pluies d'orage, l'ensemble de ces travaux nous a coûté en tout L.E. 108 375. Enfin les portions endommagées du tombeau de Seti I^{er} ont pu être consolidées pour longtemps grâce à une somme de 50 L.E. que M. Robert Mond a bien voulu mettre généreusement à notre disposition.

En ce qui concerne l'entretien, il est difficile de prévoir dès maintenant ce qu'il coûtera exactement. L'eau nécessaire est apportée à dos d'âne du village de Gourmah, et M. Zimmermann a bien voulu s'engager à diriger l'exploitation, pendant cinq ans, aux conditions suivantes :

	L.E.	MH
Ingénieur européen, par mois	5	500
Conducteur indigène, par mois	2	500
Porteur d'eau	1	200
Huiles, graisses, etc.	0	900
Pétrole, par mois (environ)	6	250
Total	16	500

Aux termes de ce contrat M. Zimmermann se déclare responsable du bon fonctionnement de l'éclairage, il paiera une indemnité de L.E. 0.400 pour chaque interruption de plus d'une heure qui serait causée par

des défauts du matériel, par la mauvaise exécution de l'installation ou par l'insuffisance de la surveillance. Aux termes de cet engagement la machine devra être prête chaque jour pendant la saison d'hiver, du 15 novembre au 15 avril, à fournir la force nécessaire pour éclairer deux ou même trois tombes à la fois depuis 9 heures du matin jusqu'à une heure de l'après-midi. J'estime qu'une somme de L.E. 200, suffira probablement à assurer la marche du service, mais nous ne serons édifiés sur ce point de façon définitive qu'après une expérience de plusieurs années. En attendant, une délibération du Comité d'Archéologie, approuvée par le Ministère, m'a autorisé à élever le prix des billets de la Haute Égypte de P.E. 100 et 50 à P.E. 120 et 70 respectivement, afin de couvrir nos frais. Toutes les personnes qui sont descendues cet hiver ont constaté l'amélioration très grande que le système d'éclairage nouveau y a introduite; non seulement on voit mieux les tableaux peints ou sculptés sur les murs mais l'atmosphère, qui parfois, après la visite d'une bande de touristes armés de bougies ou de lampes au fil de magnésium, restait presque irrespirable pendant une heure ou deux s'altère à peine et se renouvelle aisément.

Pour compléter l'organisation du service dans la Vallée des Rois, j'ai décidé de faire établir vers le milieu de la vallée, des barrières ne permettant le passage qu'à une ou deux personnes à la fois, ce qui facilite à nos gâfirs la vérification des cartes des touristes. Les sentiers conduisant aux tombes principales ont été débarrassés des pierrailles qui les encombraient et garnis sur les deux côtés d'une bordure de grosses pierres qui en limite exactement le tracé. Enfin presque en face du tombeau d'Amenothès II, vers l'endroit où commence le sentier qui mène par-dessus la montagne à Deir el Bahari, nous avons établi une sorte de parc couvert où une centaine d'ânes peuvent trouver un abri en attendant que les voyageurs aient achevé la visite des tombeaux. Enfin le commandant de la police locale a bien voulu mettre à notre disposition un de ses meilleurs sous-officiers qui, les jours où plusieurs compagnies de touristes font l'excursion, prête à nos gâfirs l'aide la plus efficace pour maintenir l'ordre dans la vallée.

2 *Inspectorat du Nord.* — L'inspectorat du Nord, de Nag Hammadi à la mer, ne contient qu'un petit nombre de temples, dont les mieux conservés sont ceux d'Abydos: presque partout les sites des cités anciennes ont été ravagés par les habitants des villes et des villages modernes qui y ont dépecé les ruines pour construire leurs maisons avec les débris. La surveillance des monuments proprement dits et leur entretien sont donc peu de chose relativement à ce qu'ils sont dans

l'inspectorat du Sud, mais par contre, la défense des terrains antiques, la prise du sébakh et la vente des matériaux, y exigent une attention de tous les instants. M. Quibell est contraint à courir sans cesse d'un bout à l'autre de sa province pour empêcher les usurpations de sites ou de buttes à sébakh et pour décider s'il convient de vendre ou de réserver certains tels que les propriétaires riverains demandent à acheter. La tâche est compliquée encore par les menées des marchands d'antiquités européens ou indigènes qui battent sans relâche le pays et entretiennent dans les villages des agents qui achètent les objets ou fouillent les cimetières à leur intention. Dans beaucoup de localités, à Zagazig, à Tell-Robâ, à Tell-Mokdam, à Sa-el-Hagar, à Alexandrie, à Gizeh, à Mellaoui, à Siout, autour d'Abydos, ils ont organisé des bandes qui dévastent les nécropoles et qui parfois, lorsqu'elles sont surprises par nos gardiens, leur livrent bataille. M. Quibell a, cette année comme les précédentes, employé le meilleur de son temps à mener des enquêtes sur des affaires de ce genre, travail ingrat s'il en fut et dont les résultats ne se font sentir qu'à la longue, par l'arrestation de quelques voleurs et par la diminution progressive des objets de grande valeur sur le marché des antiquités. Il a pourtant participé au déblaiement d'une petite nécropole nouvelle dans le Gebel Abou-Féla près de Koséir-el-Amarna, ainsi qu'à celui du petit temple de Ménéphthah mis au jour, en 1901, à Echmounéin par les preneurs de sébakh. Il a de plus consolidé les parties du temple de Sêti I^{er} à Abydos qui menaçaient le plus de s'écrouler : cette opération que j'avais annoncée déjà dans le rapport de 1901 n'a pu être poussée jusqu'au bout de cette année, faute d'argent : elle s'achèvera en 1903, si l'état de nos fonds le permet.

Je signalerai, en terminant, une lacune fâcheuse dans l'organisation de notre service. Nos deux inspecteurs en chef doivent entretenir tant avec le secrétariat central qu'avec les agents placés sous leurs ordres et avec ceux d'autres administrations de l'État Egyptien, une correspondance en langue arabe ou européenne qui augmente chaque jour de volume et d'étendue : or, aucun poste nouveau de secrétaire n'a été institué à leur intention, au moment où leur fonction fut créée en 1899. M. Quibell, dont le lieu d'attache est le Caire, remédie aisément à cet inconvénient, en se servant du bureau central pour la traduction et pour la rédaction de sa correspondance : j'ai dû autoriser M. Carter, qui réside à Thèbes, à enrôler deux écrivains, tout fois ces deux employés, engagés à titre provisoire et payés maigrement, ne possèdent ni l'instruction ni la capacité nécessaires : je suis forcé souvent de renvoyer à M. Carter des pièces comptables mal établies, ou des lettres si incorrectes qu'on a peine à comprendre le détail des affaires qui y sont traitées. Il y a lieu,

je crois, de remédier à cet état de choses qui nuit à la régularité du service, et d'organiser un secrétariat pour chacun des inspecteurs en chef : ce serait une somme de L. E. 400 environ à inscrire à l'un de nos plus prochains budgets.

Inspecteurs indigènes et ghaffirs. — Quelques changements sont survenus dans le personnel de nos inspecteurs indigènes. Le Cheikh Mansour qui avait été proposé en 1901 par M. Carter pour l'inspection de Gournah, n'a pas été nommé définitivement au bout de son année d'essai, et le poste qu'il occupait est encore vacant. L'inspecteur d'Assouan, Abdoul Megid effendi Loutfi, a été appelé au Caire pour insuffisance dans le service à la demande de M. Carter, et demeure en disponibilité dans les bureaux de l'administration centrale : son district a été placé provisoirement sous les ordres de Mahmoud effendi Mohamed, inspecteur d'Edfon. Enfin, Mohammed effendi Dohér, inspecteur de Galioubieh et Menoufieh a été mandé au Caire à la fin de novembre 1901 pour prendre part au déménagement du Musée, et son district a été partagé provisoirement entre l'inspecteur de Zagazig, Ali effendi Habib, qui a reçu la moudirich de Galioubieh, et l'inspecteur de Tantah, Youssuf effendi Neçim, qui a reçu la moudirich de Menoufieh. La partie nord-ouest du Béhéra a continué, comme en 1901 à former un petit inspectorat spécial sous l'administration de M. Botti, conservateur du Musée d'Alexandrie.

Les inspecteurs indigènes, stimulés par les inspecteurs généraux, ont redoublé d'activité. Il n'y a plus à faire l'éloge d'Ali effendi Habib ni de Mahmoud effendi Mohammed : le Musée doit au premier de n'avoir point perdu la riche momie d'époque grecque, découverte par les preneurs de sébakh à Tell Robà. Mohammed effendi Chabân, inspecteur de Rodah, a déblayé et décrit dans un rapport spécial les tombeaux de la VI^e Dynastie, trouvés à Kosêir El-Amarnah. Les deux inspecteurs proposés en 1901, Youssuf effendi Neçim et Salib effendi Rizk se sont mis rapidement au courant de leurs fonctions nouvelles, et ont été nommés à titre définitif inspecteurs de troisième classe. Tous les autres ont donné des marques répétées de leur bonne volonté et mériteraient une augmentation de solde qui compensât dans une certaine mesure le surcroît considérable de fatigue que la réorganisation du Service leur a imposé depuis quelques années. J'ai proposé pour l'année 1903, la suppression d'un poste d'inspecteur de troisième classe et son remplacement par un poste nouveau d'inspecteur de première classe qui serait attribué au plus ancien de nos officiers Ali effendi Habib : je pourrais ainsi transférer de la troisième à la seconde classe l'inspecteur Mahmoud

effendi Mohammed. J'espère qu'il sera possible de donner suite à cette proposition et de donner ainsi à deux de nos employés la récompense que leurs services leur ont méritée depuis longtemps.

Il m'avait semblé à mon retour que l'organisation intérieure des districts était abandonnée entièrement au caprice des inspecteurs locaux, et que ceux-ci-ignorants pour la plupart les principes les plus élémentaires de l'administration ne savaient pas tirer un parti suffisant des éléments qu'ils avaient à leur disposition. J'aurais souhaité réformer cet état de choses dès le début, mais il était à craindre que la plupart d'entre eux seraient peu enclins à sortir de la routine dans laquelle ils s'étaient enfermés depuis leur entrée au service, et qu'en voulant les obliger à trouver des procédés nouveaux je ne réussisse qu'à confondre leurs idées sans avantage réel pour la bonne marche des affaires. La manière intelligente dont Sobhi effendi Arif avait ordonné l'inspection de Dendérah où je l'avais envoyé dans les derniers jours de 1899, me décida en mars 1901 à lui confier l'inspection du Fayoum, l'un de ceux où il y avait le plus à faire pour assurer la régularité de la surveillance, : je lui donnai carte blanche pour le choix et la répartition des ghafirs sur les sites antiques, pour la répression des fouilles clandestines pour la prise du sébakh et pour la vente des matériaux. Après avoir consacré les quatre premiers mois de son séjour à parcourir sa circonscription, qui comprend les deux moudirihs de Fayoum et de Beni-Souef et à se rendre compte des conditions locales, il se mit à l'œuvre si vigoureusement qu'en moins d'un an et demi il parvint non seulement à remettre l'ordre partout, mais à créer un type d'administration qu'il sera facile désormais d'appliquer aux autres inspections avec les modifications de détail rendues indispensables par la nature de chacun d'eux. Son rapport pour l'année 1902 sera envoyé aux autres inspecteurs pour leur servir de modèle. J'espère, en appliquant les procédés qui lui ont réussi, établir progressivement un contrôle de plus en plus efficace sur les monuments et sur les sites dont la garde nous appartient.

Le nombre des ghafirs et des reïs n'est pas augmenté sensiblement depuis l'an dernier. Je n'ai nommé de ghafirs nouveaux que dans quelques localités où des découvertes récentes m'obligeaient à redoubler la surveillance. Surveillés de près par les inspecteurs ils ont dans plus d'un endroit empêché des fouilles illicites ou saisi le produit de ces fouilles. A Sakkarah, à Dahhour, au Fayoum, dans les moudirihs de Minieh et de Siout, ils ont dû repousser à plusieurs reprises des attaques à main armée sur les monuments et quelques-uns d'entre eux ont été maltraités ou blessés dans la défense des intérêts du Service. Le tableau suivant donne le nombre de ces gens, leur répartition à la surface

du territoire égyptien, la quotité de leur solde et les fonds sur lesquels elle est imputée.

INSPECTORAT.	Nombre.	Sur ch. 1 art. 2 Personnel Hors cadre.	Sur ch. 1 art. 1. Fouilles.	Fonds des Touristes.
		FR. M.	FR.	FR. M.
<i>Inspectorat du Nord :</i>				
Menoufiéh-Galioubieh	2	12	12	—
Zagazig	9	96	12	—
Tantah	5	36	24	—
Fayoum... ..	20	180	72	—
Rouah	24	99.600	24	168
Abydos	13	36	24	105
<i>Inspectorat du Sud :</i>				
Dendérâh	12	24	12	110.400
Louxor	15	12	—	174
Gournah... ..	39	12	144	409.200
Edfon	12	48	—	96
Assouân... ..	10	60	—	48
<i>Reliant du Musée directement :</i>				
Gizéh	7	36	—	72
Mit-Rahiméh... ..	7	43.200	—	66
Sakkarah	37	223.800	—	362.400
Total... ..	212	918.600	324	1611

On notera que L.F. 1,611 sont prélevées sur le fonds des touristes, c'est-à-dire sur un fonds qui peut nous manquer brusquement : qu'une épidémie survienne, comme ça été le cas cette année, et ce fonds diminuant ou même se réduisant à rien, nous serons obligés de licencier plus de la moitié des gardiens et de laisser les monuments à la merci des voleurs. J'ai signalé déjà l'irrégularité de cette combinaison qui impute une dépense nécessaire et constate sur une ressource aléatoire : je ne puis qu'insister plus fortement encore dans un moment où l'événement semble justifier si tristement mes prévisions. J'ajoute que la consolidation de cette dépense et son inscription au budget régulier, en dégagant le fonds des touristes nous permettrait de consacrer les ressources qu'il nous procure d'ordinaire à la réfection des monuments et de prévenir dans bien des cas des accidents semblables à ceux que j'ai déplorés au début de ce rapport.

Contentieux et loi sur les antiquités. — Comme chaque année l'application du règlement sur la prise du sébakh nous a obligés de traduire devant les tribunaux un certain nombre de délinquants. Il est à remarquer que les contraventions sont rares dans les sites pauvres en antiquités où les paysans s'inquiètent surtout de se procurer l'engrais, ils se soumettent docilement aux mesures que nous prenons pour régulariser les opérations et ils acquittent sans répugnance la taxe très légère que leur impose le choix des ghafirs. Au contraire, dans les endroits où il y a beaucoup d'objets antiques épars dans le sébakh, à Zagazig, à Benha, à Tell-Robâ, à Tell-Firâoun, par exemple, les paysans refusent de se soumettre à notre surveillance, dans l'espoir qu'un coup de pioche heureux leur fera découvrir un dépôt de bronzes, ou de monnaies, des figurines de divinités en faïence, des bijoux, un tombeau intact dont la momie sera décorée richement. Ils se refusent de payer le surveillant ; ils se refusent de travailler dans les endroits qui leur sont désignés et où nous entretenons des ghafirs, quand même ces endroits renferment un sébakh plus gras ou sont plus rapprochés de leurs habitations que les endroits où on les surprend. C'est là que les contraventions se multiplient et nous sommes contraints de réclamer l'intervention de la police et du parquet : les condamnations ne ralentissent point la fraude et cela se comprend, quand on songe que le risque d'une amende de quelques piastres et d'un emprisonnement de quelques jours est plus que compensé fréquemment par la découverte d'objets antiques qui leur rapporteront plusieurs centaines de livres.

La répression des fouilles clandestines et la saisie des objets volés par les fouilleurs expose nos agents à des poursuites judiciaires de la part des voleurs ou même à des attaques à main armée. Le préjugé qui consiste à considérer les objets d'antiquité et les monuments comme une manière de bien commun qui est à la merci de qui veut le prendre et que le premier venu a le droit de s'approprier sans commettre un délit est si fort encore par toute l'Égypte que la magistrature elle-même n'en est pas exempte : elle acquitte le plus souvent les prévenus, et peu s'en est fallu à plusieurs reprises qu'elle ne condamnât nos agents pour s'être défendus et avoir défendu les monuments contre les entreprises des fouilleurs de profession. Lorsque nous obtenons une condamnation, l'insuffisance de la législation est telle en ce qui concerne les antiquités, que la peine est toujours insignifiante. Afin de remédier à cette impaisance de la loi j'avais soumis au Ministère des Travaux publics en 1901 tout un ensemble de mesures destinées à donner au service les armes légales qui lui manquaient pour défendre la portion du patrimoine de l'État égyptien confiée à ses soins. Ce projet d'une loi sur les antiquités

comprenait la matière non seulement d'une loi, mais de plusieurs règlements propres à compléter la loi et à en régler l'application : à côté de chaque article, on y voyait deux extraits des règlements et circulaires rédigées à différentes époques sous Méhémet Ali et sous ses successeurs puis les dispositions analogues des lois et règlements actuellement en vigueur dans les pays dont la condition se rapproche le plus de celle de l'Égypte, l'Empire Ottoman, la Grèce et la Tunisie. Ce document a été soumis au Comité d'archéologie dans plusieurs séances de l'année 1902, et revu par le Contentieux du Ministère des Travaux publics : enfin, dans la séance du 29 novembre, il en a été extrait, avec le concours de M. de Rocca Serra, un projet définitif, qui a été traduit en arabe, puis imprimé en une brochure spéciale. Cette dernière rédaction a été remise au Ministère des Travaux publics pour être présentée aux autorités qui doivent décider s'il y a lieu de l'approuver ou de la rejeter. Au cas où elle serait adoptée, le Service des Antiquités aurait enfin les moyens de défendre les monuments et d'empêcher la destruction ou la dispersion des documents les plus précieux pour l'histoire la plus vieille de l'Égypte et des contrées qui bordent la Méditerranée orientale.

II. — LES FOUILLES ET LA RÉFECTION DES MONUMENTS.

Comme les années précédentes, la plus grande partie des fouilles proprement dites a été faite par des savants indépendants du Service. Chacun d'eux a publié sur ses travaux personnels des rapports ou des mémoires qui en rendent un compte exact : je me bornerai donc à indiquer sommairement les localités qu'ils ont explorées et les résultats principaux qu'ils ont obtenus.

MM. Grenfell et Hunt ont continué la recherche des papyrus grecs au Fayoum et dans les ruines d'El-Hibé : une petite nécropole de crocodiles qu'ils ont eu la chance de découvrir leur a rendu des documents intéressants d'époque grecque et romaine, mais ils pensent avoir épuisé les sites du Fayoum, et ils se préparent à transporter leurs chantiers sur d'autres points de la vallée. M. Rubensohn, agrissant pour le compte d'une société allemande, n'a obtenu qu'un gain médiocre dans les localités voisines de l'entrée du Fayoum, mais MM. Juognet et Lefebvre, qui étaient envoyés par l'école française d'Athènes, ont été plus heureux dans les régions méridionales de la province. Ils ont recueilli à Medinet-Madi et à Medinet Nahas des actes gros assez nombreux ; ils ont reconnu l'emplacement du bourg antique de Magdola, et ils ont déblayé le petit temple de la localité : ils y ont copié une longue inscription grecque du II^e siècle avant notre ère, qui semble être la charte cons-

titutive du sacerdoce local, et ils y ont mis au jour des fresques assez considérables partie ptolémaïques, partie romaines, qui ont été dessinées et reproduites en couleur par Madame Jouguet.

L'Institut français d'archéologie a continué ses recherches sur deux points : près d'Abou Rouche, M. Chassinat, aidé de M. Gombert, a terminé la reconnaissance et les relevés de la pyramide du roi Didoufri, ainsi que ceux d'une portion de la nécropole avoisinante. A Baouît, M. Clédat a commencé le déblaiement d'un ensemble de chapelles coptes des plus remarquables, décorées de peintures à la détrempe représentant pour la plupart des sujets religieux empruntés à l'ancien et au nouveau Testament : un petit nombre seulement a résisté à l'action de l'air, mais tous ont été copiés et reproduits à l'aquarelle à mesure qu'ils sortaient de terre. Vers le mois de février, M. Clédat, craignant de ne pas pouvoir achever sa tâche en temps utile, demanda à M. Chassinat de venir à son aide : M. Chassinat accourut, et, avec le concours de MM. Palangue et Gombert, il acheva de déterrer l'édifice et de photographier les tableaux. Les fouilles terminées à la fin de juin, ont donné au Musée d'excellents spécimens de la sculpture et de l'architecture copte. Les bâtiments eux-mêmes paraissent avoir été construits du VII^e au IX^e siècle, mais je crois que la plupart des peintures ne sont pas antérieures à la grande époque de la dynastie macédonienne du X^e au XI^e siècle après J.-C. Le tout nous fournit un ensemble unique jusqu'à présent de monuments appartenant à une forme provinciale bien définie de l'art byzantin. Les fouilles de Baouît sont certainement les plus importantes de celles qui ont été faites au cours de l'année 1902 par les savants étrangers au Service.

Les sites thinites ont été exploités cette année encore par trois missions : Abydos, par M. Flinders Petrie, pour le compte de l'*Egypt Exploration Fund* ; Beit Khallaf, par M. Garstang, pour le compte de l'*Egyptian Research Account* ; enfin Naga-ed-Dêir, et le voisinage, par M. Reisner, pour le compte de l'Université de Californie, subventionnée par Madame Hearst. Les fouilles de M. Reisner ont été particulièrement fructueuses en documents des plus anciennes époques de l'Égypte, et elles ont valu au Musée une précieuse collection de bijoux en or des premières dynasties. Elles ont été menées d'ailleurs avec une conscience admirable et il est à souhaiter que M. Reisner publie prochainement au moins un choix des milliers de photographies qu'il a exécutées au cours de ses déblaiements : ce sera une contribution mémorable à la connaissance des populations de l'Égypte archaïque.

M. Gayet a poursuivi, non sans succès, son exploration des cimetières byzantins d'Antinoé. Il y a recueilli quantité d'objets du même genre

que ceux qui lui avaient valu un si grand succès de curiosité au cours des années précédentes, momies ou plutôt corps modifiés de religieux, emblèmes et ustensiles sacrés, mobilier, étoffes, chaussures, et quelques fragments de papyrus coptes. J'en ai retenu bon nombre pour les collections du Musée.

M. N. de G. Davies a travaillé cette année encore dans l'intérêt de l'*Archeological Survey of Egypt* : il a copié une partie des hypogées qui forment le groupe septentrional d'El-Amarna. M. Newberry, aidé d'un jeune américain, M. Titus, a déblayé quelques tombes nouvelles à Cheikh Abd-el-Gournah, et repris l'exploration d'un palais d'Aménorrhès III dont les ruines avaient été découvertes par M. Grébaut au sud de Médinet-Habou. Il a mis au jour un certain nombre de salles, salle du trône, salle d'audience, antichambres, chambres à coucher, qui toutes contenaient des pavements peints de même style que ceux du palais d'Aménorrhès IV à El-Amarna : des débris de murs, de corniches et de plafonds permettront de reconstituer dans l'ensemble la décoration des parties détruites. Un peu plus loin, il a fouillé les maisons habitées par le personnel inférieur de la ville royale, celles surtout où vivaient les émailleurs et les fondeurs : il a recueilli des résidus de fabrication et des morceaux de vases, mais le site, bouleversé depuis douze ans par les fouilleurs indigènes ne lui a rendu aucun de ces beaux objets en émail bleu qu'il espérait y rencontrer.

L'Académie des sciences de Berlin a repris les recherches qu'elle avait instituées les années précédentes dans le champ d'Abmâr. Comme d'habitude M. Borchardt a dirigé les opérations, aidé cette fois du Dr. Rubensohn. Ils ont achevé de relever le temple solaire du Pharaon Niousirri de la V^e dynastie et ils ont attaqué sa pyramide royale : le Musée a eu pour sa part des dépouilles, une belle colonne de granit à chapiteau en bouton de lotus, qui provient de la chapelle, ainsi que de belles figures de lions, et quelques recueils curieux de basse époque. Le morceau le plus important est allé à Berlin : c'est un rouleau de papyrus contenant quatre cents vers environ en dialecte dorien d'un des plus célèbres poètes lyriques de la Grèce Timothée, de qui l'œuvre entière était inconnue jusqu'à présent.

À côté des savants, des amateurs ont entrepris des recherches sérieuses ; Daninos Pacha à Atfih, à Téhneh, à Matariéh ; lady William Cecil, en face d'Assouan, au pied de la Koublèt-el-Hania ; MM. Mallard et Covington auprès des Pyramides de Gizéh. Les fouilles de Daninos Pacha ont peu produit ; les autres au contraire ont été riches en résultats. Lady William Cecil, dirigée par M. Carter, a exploré d'abord une nécropole d'âge romain, situé à l'est du Dêr Amba Siman, puis

elle a transporté son chantier au voisinage des tombes découvertes en 1885-1886, et elle a fait connaître un hypogée de la XVIII^e ou de la XIX^e Dynastie, décoré de peintures curieuses. Le rapport qu'elle m'a adressé sur ses opérations paraîtra dans un prochain numéro des *Annales*. M. Mallard a ouvert une demi-douzaine de petits mastabas de la IV^e Dynastie et il en a tiré quelques statues d'assez bon style, dont le Musée a retenu les meilleures. Quant à M. Covington il est tombé du premier coup sur un immense mastaba, analogue pour la décoration extérieure au tombeau de Neggadah, et qui doit appartenir, comme celui-ci aux temps archaïques de l'Égypte. Les concessions accordées à ces personnes ont provoqué des réclamations dont l'écho a retenti jusque dans le Comité d'Archéologie : il a été proposé de repousser désormais toutes les demandes de ce genre et de n'accorder les autorisations de fouiller qu'aux savants appuyés par leurs gouvernements ou envoyés en mission par des universités ou par des académies. Plusieurs, dont je suis, ont objecté que le service, ne pouvant défendre efficacement tous les sites avec les ressources restreintes dont il dispose, avait intérêt à en permettre l'exploitation aux personnes honorables qui acceptaient de travailler sous sa surveillance et à ses conditions : si les travaux ainsi entrepris ne sont pas toujours menés d'une manière aussi scientifique que les autres, du moins les résultats en sont connus et ils procurent au Musée beaucoup d'objets intéressants. En supprimant le droit de fouilles pour les amateurs, ce ne sont point les savants qui profiteront le plus souvent des localités réservées, ce seront les fouilleurs indigènes ; des monuments précieux seront détruits ou dispersés sans profit pour la science que l'on voudrait favoriser. La question ainsi posée n'a pas été résolue encore, mais en attendant qu'elle le soit, le Comité a décidé de n'accorder aucune concession nouvelle aux amateurs. Ceux-là seuls pourront fouiller pendant l'hiver de 1902-1903, qui y avaient été autorisés antérieurement à la décision.

Le service n'entreprend de fouilles proprement dites que lorsque les circonstances l'y contraignent, pour épuiser un site menacé par les voleurs et dont nul savant du dehors n'a réclamé la concession, ou pour vérifier le dire de quelque indigène qui prétend connaître quelque tombeau intact. C'est ainsi que sur les indications d'Ali Effendi Habib, M. Quibell a fait ouvrir à Tell Roba une sépulture d'époque grecque, dont la momie portait tout un attirail de bijoux en or ou en argent doré : à Kosêr-el-Amarnah, l'inspecteur Mohammed Effendi Chaban a fouillé de même, sur le rapport de M. Mirri Nasr, maître d'école copte à Nazali Gamouh, une petite nécropole de la VI^e Dynastie. Près

de Matarieh, Ahmed Bey Kamal, Conservateur adjoint du Musée, a déblayé une sorte de chapelle qu'un certain Mohammed Tawél lui avait signalée, et qui s'est trouvé être l'hypogée d'un Muévis de Ramsès III; le petit monument a été transporté au Musée pendant le mois de juillet, et il sera remonté dans un coin de jardin. Sauf ces cas et des cas analogues, le service s'est contenté, cette année de même que les années précédentes, de consolider et de réparer les monuments.

J'ai indiqué déjà ce qui a été fait à Kom Ombo et à Edfou par M. Carter, au temple de Séri 1^{er} à Abydos par M. Quibell; notre activité s'est portée, comme d'habitude, sur trois points, à Sakkarah où nos travaux sont imputés sur les fonds ordinaires de notre budget, à Karnak et à Philæ pour lesquelles la Caisse de la Dette et le Ministère nous ont alloué des crédits spéciaux. A Sakkarah nous avons dû consolider en plusieurs endroits les galeries du Sérapéum qui menaçaient de s'écrouler, et enlever quelques stèles de protection difficile que nous craignions de voir dérober par les voleurs; elles sont aujourd'hui en sûreté dans le Musée. J'ai, de plus, fait démonter un petit mastaba de la IV^e Dynastie, celui de Khouïthapou, qui a été vendu à M. Gockopp et donné par lui au Musée de Leyden. Toutefois, le gros de notre travail s'est concentré autour de la pyramide d'Ounas. J'avais entrepris, dès 1899 de la déblayer complètement, partie pour vérifier certaines idées que j'avais au sujet des tombes royales de l'époque Memphite, mais surtout pour donner aux touristes qui visitent Sakkarah l'idée complète de ce qu'étaient ces tombes. M. Barsanti a terminé cette année de dégager le corps même de la pyramide : il a de plus poussé fort loin le déblaiement de la chapelle et des propylées attachées à l'édifice. Il a découvert, au cours de travail, plusieurs hypogées saïtes analogues à ceux des années précédentes, et qui ont rendu le contingent habituel de statuettes bleues et d'annelettes funéraires en or, en argent doré et en pierres fines. Toutefois la grande découverte de l'année a été faite dans les galeries de l'est. J'avais été frappé, l'an dernier, de l'aspect archaïque qu'elles présentaient et je m'étais demandé si elles n'avaient pas appartenu à quelque tombeau plus ancien que les architectes d'Ounas avaient réemployé; les rois Khalifa et Roubi, qui avaient reçu la recommandation d'y recueillir soigneusement jusqu'au plus petit fragment de vase qu'ils rencontreraient, ont recueilli en effet des chapaux de terre glaise identiques à ceux que MM. Amélineau et Petrie ont trouvés à Abydos, et qui portent les noms de double de deux très vieux rois, Rânibou et Hatpousakhmoui. L'époque archaïque commence donc à se manifester à Sakkarah comme dans Saïd, et il nous faudra reprendre toutes les fouilles de Mariette dans le champ des

Pyramides, en cherchant les monuments thinites qui lui avaient échappé.

A Karnak, M. Legrain a continué la réfection des colonnes de la salle hypostyle et entrepris sur les indications que je lui avais données le déblaiement de la cour située au sud-est de la salle hypostyle, entre le mur extérieur du grand temple et le premier pylone de Thoutmosis III. Les fondations des onze colonnes ont été refaites des premiers jours de janvier aux premiers jours d'avril : elles ont subi l'épreuve de l'inondation, et dans la dernière semaine de décembre, M. Legrain a commencé le remontage des colonnes. Elles seront toutes relevées jusqu'à la hauteur de six mètres environ, après quoi l'on arrêtera le travail : il ne reprendra qu'à l'automne de 1903, lorsque la crue étant passée nous aurons pu vérifier si elles ont conservé leur aplomb. D'autre part, le déblaiement de la cour a produit des résultats intéressants, la découverte d'une douzaine de colosses en granit rose parmi lesquels je signalerai celui d'un Pharaon encore inconnu de la XIII^e Dynastie, un Ousirtasen IV, puis celle de blocs en calcaire couverts de sculptures superbes et provenant du temple de la XII^e Dynastie, ainsi que d'un édifice d'Aménôthès I^{er} ; Thoutmosis III les avait employés comme remblais au temps où il releva le sol de la cour, et, si les travaux de cette année-ci nous en rendent d'autres je me propose de rebâtir dans un coin de Karnak l'édifice auquel ils appartenaient, je crains toutefois que beaucoup d'entre eux n'aient été utilisés dans les fondations du pylone, auquel cas, ils seraient probablement perdus à jamais. Pour en finir avec ce qui concerne Karnak, je rappellerai que le Ministère nous a ouvert un crédit de L. E. 165 à l'effet de ferrer la route qui réunit la ville de Louxor aux ruines de Karnak. Ce travail, commencé en novembre seulement était mené à moitié dans les derniers jours de décembre ; la chaussée en était achevée et bordée de trottoirs en pierre de la porte sud du temple de Khonson jusqu'à la hauteur des cinetières européens. Les dépenses imputées sur le compte Karnak de L. E. 2,000 à la fin de décembre 1902 se répartissaient comme il suit :

	L. E.	MILL.
Achat et transport de matériel	952	869
Déblaiements et restaurations	831	983
Frais de déplacements... ..	69	787
Appointements d'un contre-maitre européen	21	600
Gardiennage	23	360
Total	L. E. 1899	599

Les travaux de Philae, pour lesquels le Ministère nous avait ouvert un crédit de L.É. 2,454, ont été confiés à M. Barsanti qui avait déjà dirigé les déblaiements de l'île, il y a quelques années. Ils ont dû être menés très rapidement car en premier lieu la réfection des fondations confiée au D^r Ball a duré jusqu'en mai, et, pendant l'été, l'épidémie de choléra ne m'a permis de rien faire avant le milieu d'octobre ; ils n'ont été terminés que vers le 3 décembre, au moment où une partie de l'île était déjà sous l'eau. M. Barsanti a démonté au sud le petit pavillon de Néctanébo dont les colonnes étaient chancelantes, puis il l'a remonté en remettant à leur place antique les blocs épars sur le sol ; il a complété le petit temple d'Arnoufis, nettoyé et rempli de ciment tous les joints de la maçonnerie du portique et du grand temple, consolidé les corniches des pylones, rebâti les propylées de la chapelle d'Hathor. L'ensemble de ces travaux a coûté L.É. 674,366 ; sur les L.É. 1,779,644 qui existaient encore de notre crédit, 1,000 ont été utilisées provisoirement, ainsi que je l'ai dit, pour la consolidation du mur ouest d'Edfon, les L.É. 779,644 restantes demeurent inscrites à notre compte en vue des réparations à faire lors du retrait des eaux. J'ai inspecté avec soin les édifices de Philae le 9 décembre, et j'ai pu constater que rien n'avait été négligé pour les mettre en état de résister à leur séjour prolongé dans le Nil. J'ai remarqué que les blocs de grès, devenus complètement anhydres après dix-huit siècles d'exposition à l'air sec, absorbaient l'eau avec une rapidité inquiétante : au mur ouest du portique occidental, elle avait pénétré par capillarité à plus de deux mètres au-dessus du niveau du fleuve. Sur tout le parcours de l'ancien bras qui séparait le rocher du sud-est du double portique, le sol était déjà détrempé et s'enfonçait sous le pied, menaçant d'enliser le promeneur : on peut redouter que l'alluvion ne soit emportée rapidement, et que le kiosque de Trajan en souffre grandement. Toutefois on ne peut rien prévoir encore de ce qui se passera, et nous ne serons fixés sur les chances de durée des monuments qui couvraient l'île que l'été prochain, lorsque les eaux seront revenues à leur niveau habituel.

Quelques réparations ont été exécutées dans des localités moindres, à El-Amarna, à Mit-Rahinéh où nous avons dû reconstruire l'abri de l'Abou'l-Hôl à Médinet-Habou. Le plan de la nécropole thébaine a marché assez rapidement ; M. Baraize a relevé et mis au net quatre fouilles la colline entière de Cheikh Abd-el-Gournah. Notre dépense totale, abstraction faite de sommes consacrées sur allocation spéciale à Karnak et à Philae, s'est répartie comme il suit, au 8 décembre.

	Sous-Chapitre 2. Art. I. Fouilles.		Fonds des Touristes.	
	£ E.	Mill.	£ E.	Mill.
Tel Rohâ	15	520	—	—
Kom-esl-Shoukafa.	67	050	—	—
Gabari	15	250	—	—
Mahfroussa	1	050	—	—
Héliopolis.	4	580	—	—
Gizéh.	43	520	—	—
Sakkarah.	561	680	4	985
Mit-Rahinéh	11	460	12	620
El-Amarna	—	—	3	670
Hagi-Kandil	—	—	1	259
Kasr-el-Amarna.	3	870	—	—
Abydos	10	560	262	603
Louxor	—	—	1	195
Medinet-Habou	—	—	4	030
Biban-el-Melouk (y compris l'électricité)	—	—	791	328
Cheikh Abd-el-Gournah (plan de la nécropole)	—	—	28	740
Edfou	—	—	128	861
Kom Ombo	—	—	25	205
Philæ	—	—	—	540
Sites divers	2	600	—	—
Achat d'antiquités.	61	880	—	—
Gratifications pour antiquités indiquées ou livrées par les inventeurs	68	870	—	—
Total... ..	874	400	1,265	066

La générosité de quelques particuliers a permis à M. Carter d'exécuter dans la Vallée des Rois quelques fouilles et quelques réparations supplémentaires. Une voûte du tombeau de Sêti I^{er} a été consolidée sur les indications et aux frais de M. Mond. Madame Goff a donné l'argent nécessaire à débiter et à clore le tombeau de Sêti II. Enfin des ouvriers payés par M. Théodore Davies ont fouillé l'un des ravins voisins de la tombe de Sêti I^{er} : il semble que nous soyons sur le point de retrouver l'hypogée de Thoutmôsis IV. Des objets ayant appartenu au prince Maherprâ, entre autres un coffre renfermant deux corselets en cuir finement découpés, ont été trouvés à même le sable, pendant ces fouilles. J'ai lieu de croire que M. Davies nous fournira cet hiver la somme nécessaire à terminer cette fouille.

III. — LE MUSÉE ET LES PUBLICATIONS DU SERVICE.

Une moitié de l'année 1902 a été occupée par le déménagement de l'ancien Musée de Gizéh et par le transport des collections dans les bâtiments nouveaux de Kasr-el-Nil.

L'opération avait été préparée de longue date et c'est ce qui explique qu'elle ait pu s'accomplir très rapidement sans dommages sérieux. Dès la fin de 1899 j'avais commandé au menuisier en chef du service, Mohammed Issa, de fabriquer cinq cents caisses de différentes tailles et j'avais fait acheter une centaine de cafas pour les poteries, ainsi que les quantités de coton, de copeaux et de toile nécessaires à l'emballage des objets. Dès qu'un nombre suffisant de caisses fut prêt, je fis revenir M. Barsanti de Sakkarah où il était occupé à déblayer la pyramide d'Oumas, et, le 7 Mai 1900, les travaux commencèrent. Il avait été convenu qu'on fermerait progressivement les salles du premier étage que le public visitait le moins souvent ; M. Barsanti, avec un seul farrache, mit en caisse, les ostraea, les moules, les modèles d'architecture, le mobilier, les statuettes funéraires. Il interrompit le 22 octobre 1900 pour reprendre la direction des fouilles, puis, dans la seconde quinzaine de Mai 1901, il revint présider aux préparatifs du déménagement. Tandis qu'un arménien engagé au mois, M. Chachintz, mettait les cercueils des prêtres d'Amon en état de supporter le voyage, et que M. Chauvin et quatre farraches enveloppaient cent vingt de ces cercueils puis enfermaient dans les caisses la plupart des petites stèles du moyen Empire, M. Barsanti, aidé de notre peintre M. Carlo Oropesa et d'un farrache, s'occupait sans relâche des petits objets. Vers la fin de décembre cinq cent dix huit caisses étaient prêtes à partir, et il ne restait plus dans les galeries du premier étage que les objets qui devaient rester à Gizéh jusqu'au dernier moment à l'intention des touristes, les petits bronzes, les scarabées, les émaux, les momies royales : le 4 décembre, je fis embarquer sur le chaland du Musée une centaine d'armoires, de vitrines, des socles, et six jours plus tard, le 11 décembre, toutes les vitrines des salles vides étaient arrivées en deux autres voyages au Musée nouveau, où elles demeurent sous la garde de Mohammed effendi Dohéir, inspecteur de Galioubiéh-Menoufiéh, qui fut appelé au Caire pour la circonstance. Le mois de décembre 1901 et les deux premières semaines de janvier 1902 furent consacrées au numérotage des salles et la mise en place du mobilier ; à mon retour de la Haute Egypte, le 3 février 1902, toutes les galeries orientales du premier étage étaient prêtes à recevoir les monuments.

Tandis que les entrepreneurs achevaient de peindre les salles du rez-de-chaussée, les dernières dispositions furent prises au palais de Gizéh pour procéder au transport. L'Administration des Chemins de fer de l'État, qui nous a toujours aidé de son mieux, avait fini de poser les deux tronçons de lignes ferrées qui rejoignaient aux voies existantes, Gizéh et le Kasr-el-Nil et la jonction était faite entre les deux Musées ;

M. Barsanti construisit les deux échafaudages en poutres destinés à l'embarquement des monuments lourds et à leur débarquement sur les wagons, installa à Gizéh une voie Decauville qui devait mener ces monuments jusque sous l'échafaudage d'embarquement à Kasr-el-Nil et une autre voie Decauville qui, les prenant sous l'échafaudage de débarquement devait les conduire à travers les galeries jusqu'à leur place définitive. Vers le milieu de février, à titre d'essai je fis porter par eau en deux fois, 272 cercueils, puis, l'essai ayant réussi à la satisfaction générale, le 9 mars je me résolus à lancer le premier convoi de menus objets par la voie du fleuve, et le *Remorqueur N° 1*, prêté par le service technique du Ministère emmenait notre chaland à la remorque. J'ai expliqué dans le rapport de 1901 les mesures qui avaient été prises pour assurer la sécurité des transports entre les points de départ et celui d'arrivée, sous la responsabilité du Nazir Ahmed Effendi, Chouiche à Gizéh, et de l'inspecteur Mohammed Effendi Dohéir à Kasr-el-Nil ; elles se montrèrent si efficaces que le 11 mars, en trois voyages les cinq cent dix huit caisses de menus objets qui avaient été préparées au cours des deux années précédentes étaient au premier étage du Musée nouveau, chacune d'elles dans la salle à laquelle elle appartenait, au pied de l'armoire qu'elle devait remplir. Aussitôt MM. Emile Brugsch Bey et Daressy, reçurent l'ordre de se transporter au Musée nouveau et de procéder au déballage ; aidés de M. de Bissing pour les poteries, de M. Edgar pour les objets gréco-romains, puis de M. Lacau et d'un de mes anciens élèves de Paris, M. Calame, qui était de passage en Egypte, ils rangèrent hâtivement les objets dans les armoires, et dès les premiers jours d'avril, l'emménagement était assez avancé pour que toute cette partie de l'édifice eût déjà tournure de Musée. Dans l'intervalle, le chaland avait fait cinq voyages et amené la fin des sarcophages en bois, une centaine de stèles de l'ancien Empire, plusieurs des statues d'Ousirtasen 1^{er} ; le moment était venu d'utiliser la voie ferrée et d'attaquer les grands monuments.

Il avait été convenu avec l'Administration des Chemins de fer qu'elle mettrait à notre disposition dix wagons et plateformes de tonnages au prix de 10 L. E. par wagon et par mois, plus L. E. 1.150 pour chaque voyage d'un wagon chargé, sous la condition toutefois que chaque train comprendrait au moins cinq wagons ; ces dix wagons eux-mêmes seraient divisés en deux parts, cinq seraient toujours en chargement à Gizéh et cinq en déchargement à Kasr-el-Nil. Le premier train transportait quarante-huit sarcophages pesant un peu plus de cent tonnes : il fut mis en mouvement le 1^{er} avril, et il arriva au Musée nouveau en moins de deux heures. Dix-huit autres trains le suivirent du 5 avril au 13 juillet,

tandis que le chaland achevait d'emmener les monuments de moindre taille : le 29 mai les bureaux du service étaient transférés au Caire ; le 13 juillet au soir, le Musée de Gizéh était vide et le tombeau de Mariette Pacha lui-même avait été prendre sa place dans les jardins du Musée nouveau ; le 1^{er} août, nous remettions le palais et le jardin aux mains du Moudir de Gizéh, ne retenant que la partie des dépendances où ceux des employés du service qui étaient logés continuaient d'habiter encore par tolérance gracieuse du Ministère des Finances. Le déménagement avait donc duré un peu moins de cinq mois, du 9 mars au 13 juillet, et l'emménagement avait marché parallèlement au déménagement. J'avais tracé à l'avance un plan sommaire de chacune des salles du rez-de-chaussée où la place des monuments les plus considérables était indiquée ; ce premier classement dût être modifié plus d'une fois en cours d'exécution, mais il servit à trier les monuments au fur et à mesure qu'ils arrivaient et à en régler la distribution dans les salles. Tandis que MM. Brugsch Bey et Daressy achevaient de mettre en ordre les chambres du premier étage, M. Barsanti remplissait celles du rez-de-chaussée et c'est grâce surtout à son habileté comme à son énergie que nous devons d'avoir pu terminer si rapidement notre tâche. On s'en représentera aisément la difficulté si l'on se rappelle que plusieurs des grosses stèles pesaient de douze à seize tonnes et qu'une centaine au moins de nos monuments variaient de poids entre une et dix tonnes ; la mise en place opérée, par les soins des réis Khalil et Fouli, il fallait habiller les socles et peindre les bois, ce qui se fit sous les ordres du menuisier Mohammed Issa et du peintre Oropesa. Dans le même temps que les objets arrivaient, le catalogue sommaire en était rédigé puis envoyé à l'impression ; grâce à la complaisance de M. Chassinat, directeur de l'Institut français d'Archéologie, l'impression put être commencée sur plusieurs points à la fois et le tirage mené rapidement. Lorsque je partis en congé le 26 juillet, toutes les salles étaient classées à l'exception de la salle copte du rez-de-chaussée, pour l'ordonnance de laquelle je laissais à M. Barsanti les instructions nécessaires, et il ne restait plus qu'à compléter la fabrication des armoires, la menuiserie et la peinture des socles.

Les derniers travaux d'aménagement furent un peu ralentis par l'épidémie, qui obligea le directeur par interim, M. Brugsch Bey, à diminuer le nombre des ouvriers ; malgré ce contre-temps, ils étaient terminés dans la première semaine de septembre, et dès le 15 du même mois, les étrangers de passage au Caire, étaient admis à visiter les collections, lorsqu'ils se présentaient pour le faire. Notre grande préoccupation, pendant tout le temps que les opérations durèrent, avait été

d'avoir presque toujours un Musée à montrer aux touristes, et nous avons tenu quelques galeries de Gizéh ouvertes jusque dans la première quinzaine de juin ; entr'ouvrant les portes vers le 15 septembre, nous avons réussi à n'exclure les visiteurs que pendant les trois mois de l'année où ils sont d'ordinaire le moins fréquents. La classification adoptée n'est en partie que provisoire, et il n'en pouvait être autrement, données les circonstances, au moins pour ce qui concerne les salles du premier étage ; si nous avions essayé de classer à nouveau les milliers de menues amulettes qu'elles contiennent à mesure que nous les transportions, il en serait bientôt résulté une confusion au milieu de laquelle nous aurions risqué de ne plus nous reconnaître nous-mêmes et d'égarer des objets précieux. Nous nous sommes donc bornés à rétablir dans cet étage la même classification ou peu s'en faut qui prévalait dans le Musée de Gizéh et qui lui était venue du vieux Musée de Bulaq ; nous y avons établi un grand dépôt d'antiquités d'où nous ferons sortir, je l'espère, un musée classé avec ordre dans les cinq ou six années qui viendront. Au premier étage, la classification est plus régulière et elle peut être considérée comme définitive, sauf pour un petit nombre de statues que nous essaierons de mettre en meilleure lumière. J'ajoute que grâce à la précaution qui avait été prise d'emballer les pièces fragiles longtemps à l'avance, nous n'avons eu qu'un nombre très restreint d'accidents à déplorer ; une statuette en albâtre, une stèle de l'ancien Empire, et une demi-douzaine de vases en terre, ont été brisés, mais de telle façon qu'on a pu les reconstituer en entier. Le seul fait vraiment regrettable s'est passé lorsque le déménagement était déjà achevé dans les premiers jours du mois d'août. Le grand naos en bois du roi Horou, provenant de Dahchour, avait disparu à ce moment sans qu'on eût pu savoir ce qu'il était devenu ; on l'a retrouvé, le 5 janvier 1903, en morceaux dissimulés derrière des cercueils de rebut, dans les sous-sols. M. Barsanti avait donné l'ordre de l'y descendre en attendant qu'il lui trouvât une place, et les ouvriers l'ayant brisé pendant le transport, ont essayé d'effacer les traces de leur maladresse.

L'inauguration du Musée a eu lieu le 15 novembre, sous les auspices de S. A. le Khédive et en présence de toutes les notabilités du Caire. Le catalogue, ou plutôt le guide nouveau, a pu être distribué aux invités, et depuis lors le Musée a été ouvert régulièrement au public ; depuis le 1^{er} décembre, il ne ferme plus le lundi, mais le vendredi de chaque semaine, et cela, à la demande de nos employés musulmans que l'obligation d'être à leur poste le vendredi gênait dans l'exercice de leur religion. Il est difficile de dire, dès maintenant, tous les avantages et tous les inconvénients de l'édifice nouveau. Les lignes intérieures en sont

fort belles presque partout, et les monuments y sont fort à l'aise ; on peut évaluer qu'au train dont marchent les acquisitions, les salles ne seront pas pleines avant quarante ou cinquante ans. D'autre part, le système d'éclairage est défectueux et devra être réformé promptement, si l'on veut éviter que l'excès de chaleur et de lumière n'endommage ou même ne détruise nombre des monuments pendant les mois d'été ; il n'est pas certain non plus que les toits soient à l'épreuve de l'eau et les pluies médiocres que nous avons eues pendant les derniers jours de décembre 1902 ont filtré dans quelques salles de l'étage supérieur. Enfin, la surveillance y est assez difficile, contrairement à ce que l'on avait prévu d'abord, et vérification faite sur les lieux, le Comité d'Archéologie a dû réclamer une augmentation du nombre des gardiens que le Ministère des Finances a ratifiée sur le champ, nous accordant à cet effet un crédit supplémentaire de L.E. 90 ; depuis le 1^{er} septembre, le personnel des farraches a été porté de soixante-cinq à quatre-vingt cinq. Il sera facile de remédier à la plupart de ces défauts et de ceux que nous découvrirons certainement encore, à mesure que nous connaissons mieux le Musée. Les dépendances ne sont pas achevées complètement ; le bâtiment réservé aux soldats de la police ainsi qu'à nos veilleurs de nuit ne nous a pas été livré encore non plus que les magasins ni les ateliers, et la maison du Secrétariat commence seulement à sortir de terre. Tous nos services ne seront installés définitivement que vers la fin de 1903.

Une somme de L.E. 8,500 nous avait été réservée pour faire face aux frais du déménagement. Nous avons essayé de ne pas la dépasser et nous y serions parvenus probablement si certaines dépenses ne nous avaient été imputées qui auraient dû être supportées par d'autres services ; c'est ainsi qu'il nous a fallu payer l'équipement et la solde du détachement de police du Caire à qui le soin est revenu de surveiller le Musée nouveau, tandis que la police de Gizéh, la seule dont le paiement fût assuré par le budget, continuait de garder la partie du Musée qui était encore à Gizéh. J'ajouterai que, malgré que la somme de L.E. 8,500 nous fût allouée pour le déménagement seul, nous nous sommes arrangés pour qu'elle suffît aussi à l'aménagement des salles pour lesquelles nous n'avions pas de mobilier. Nous avons dû en effet fabriquer de mars à décembre 1902 une quantité considérable de socles, d'armoires, de vitrines nouvelles, qu'il a fallu ensuite peindre, garnir d'étoffe et de verre ; nous avons dû enfin, disposer et clore un certain nombre de pièces pour abriter provisoirement les conservateurs du Musée, le nazir, les farraches, les bureaux de l'administration des antiquités. Nous avons utilisé à cet effet beaucoup de portes vitrées et de glaces que nous avons emportées du palais de Gizéh avec l'autorisation du Minis-

tère des Finances, puis, quand le transport a été terminé les poutres de nos échafaudages et les traverses sur lesquelles nous avons établi dans le Musée de Kasr-el-Nil les rails de notre voie Decauville; nous avons été obligés pourtant d'acheter des quantités considérables de bois et de verres épais. Il m'est impossible de donner ici pour le moment le détail de nos dépenses, l'Administration des Chemins de fer ne nous ayant pas encore réclamé le solde de son compte, qui peut s'élever à environ L.E. 1,000; si, comme je le prévois, nous dépassons notre crédit, ce sera d'une somme qui ne saurait être inférieure à L.E. 200 et qui ne s'élèvera pas probablement au dessus de L.E. 500.

Tandis que ce travail s'accomplissait, les publications du Musée ne ralentissaient point: les *Annales du Service* achevaient leur troisième année d'existence et les volumes du Grand Catalogue se succédaient rapidement. Nous avons pu faire paraître successivement les deux volumes de M. Daressy sur les fouilles faites dans la Vallée des Rois de 1898 à 1899, le volume de M. de Bissing, sur les vases en faïence du Musée, le tome 1^{er} du Catalogue des stèles du moyen Empire par MM. Lange et Schœffer: les volumes de M. Edgar sur les moules grecs et de M. Daressy sur les inscriptions magiques sont achevés et auraient paru si la grève de Marseille n'avait pas arrêté l'envoi des planches que nous sommes obligés de faire exécuter en Europe. L'impression de plusieurs autres parties du Catalogue est fort avancée; nous aurons d'ici quelques semaines le tome IV du Catalogue des stèles du moyen Empire par MM. Lange et Schœffer, ainsi que le tome 1^{er} du Catalogue des cercueils et sarcophages en bois de l'ancien Empire par M. Lacau, et peut-être le tome 1^{er} des sarcophages des grands prêtres d'Amon par M. Chassinat. D'autre part nous avons à l'impression le tome II des stèles du moyen Empire par MM. Lange et Schœffer, le Catalogue des vases en pierre dure par M. de Bissing, celui des poteries grecques par M. Edgar, celui des monuments coptes et byzantins par M. Strzykowski, celui des stèles hiéroglyphiques d'époque grecque et romaine par Ahmed Bey Kamal, celui des papyrus grecs par MM. Grenfell et Hunt, dont les uns pourront être publiés cette année, les autres l'année qui suivra. Enfin nous avons en préparation le Catalogue des stèles du nouvel Empire et de l'époque Saïte, par M. Lacau, celui des vases en terre et des bijoux, par M. de Bissing, celui des statues et statuettes de divinités par M. Daressy, celui des tables d'offrandes par M. Ahmed Bey Kamal, celui des sarcophages en pierre des époques saïte et grecque par M. Maspero; de plus, usant de la faculté que le Comité d'Archéologie a bien voulu m'accorder d'engager pour quelques mois les égyptologues étrangers de passage en Egypte, j'ai chargé M. Newberry de rédiger le

Catalogue des scarabées et des statuettes funéraires, M. Spiegelberg de compiler celui des stèles et des papyrus démotiques. Le travail du Grand Catalogue est donc en pleine activité. J'ai, pour faire face aux dépenses d'impression et de rédaction, les économies que j'ai pu réaliser sur la somme de 2.000 L. E. que la Caisse de la Dette veut bien m'allouer chaque année, et que la Comptabilité a bien voulu me permettre de reporter d'un exercice sur l'autre. Ces économies consistent du reliquat des fonds votés en 1897 pour la confection du Catalogue, ainsi que des 800 L. E. qui durement librent chaque année par la suppression de trois des cinq membres qui composaient le Comité de rédaction à l'origine : j'ai pu de la sorte assurer jusqu'à ce jour l'impression rapide du Catalogue sans demander de nouveaux sacrifices au trésor égyptien. L'adjonction à ce comité des fonctionnaires du Musée tels que MM. Daressy et Ahmed Bey Kamal qui ne reçoivent aucune rémunération, et des égyptologues de passage qui ne touchent chacun que deux ou trois mois de traitement, m'a permis de maintenir et même d'augmenter la rapidité de l'entreprise ; autant qu'il m'est permis d'en juger, les deux tiers environ de nos collections sont catalogués et nous pouvons prévoir le moment où la rédaction, sinon l'impression du Grand Catalogue sera terminée complètement. Les membres permanents ont été cette année-ci comme l'an dernier, MM. de Bissing, Edgar et Lacau.

Malgré les difficultés que présente toujours l'impression d'ouvrages dont l'auteur est absent, nous avons réussi à avancer l'impression des deux volumes du Catalogue général des monuments de l'Égypte dont le manuscrit nous avait été laissé par M. de Morgan. Le premier fascicule du tome II de Kom Ombo a paru en décembre 1902 et le second est en bonne voie. Le second volume de Dahchour ne marche pas aussi vite que je le souhaiterais, et dix feuilles seulement en sont imprimées ; j'espère que le progrès sera plus considérable en 1903. Les frais sont imputés sur le fond de *Chakfs* comme ceux de toutes les publications ordinaires du service.

Enfin l'abondance des monuments nouveaux m'a décidé à préparer un second volume du *Musée Égyptien*. Une quinzaine de planches sont imprimées déjà ou sont à l'impression, et les parties du texte qui leur correspondent me seront remises prochainement par les auteurs ; je compte qu'une livraison de ce tome deuxième pourra paraître cette année.

Assouan, le 17 Janvier 1903.

G. MASPERO

REPORT ON AGRICULTURAL RAILWAY LINES

1902

BY

JAMES A. GUNN.

REPORT ON AGRICULTURAL RAILWAY LINES.

Cairo, 15th May 1903.

SIR WILLIAM GARSTIN, K.C.M.G.,

Under Secretary of State,

Ministry of Public Works,

SIR,

I have the honour to submit my report on the maintenance and workings of the Agricultural Light Railways for 1902.

Lines constructed during the year.

During the last year the kilometrage or mileage has only been increased by an additional 60 kilometres or $37\frac{1}{2}$ miles, viz:—thirty-nine kilometres (39) in the Fayoum Province, and twenty-one kilometres (21) in Gharbieh.

Two other short sections were under construction, but not completed, one to connect up two sections in Gharbieh, the other in Charkieh to the Stone Quarries.

This shows a falling off in construction as compared with previous years (see table below) but does not imply a diminished prosperity: it is simply a pause to enable the Companies to more fully equip the lines in order to meet the demands upon them. The work has far exceeded their expectations and they must add to their rolling stock to meet the increase of passengers and goods. This is specially noticeable in Lower Egypt where the lines are more fully connected up.

In the year 1897...	...	87.81 kiloms. or	54.5 miles.	Table showing total length of lines.
" " 1898...	...	355.00	" 221.25 "	
" " 1899...	...	694.5	" 430. "	
" " 1900...	...	920.8	" 572.1 "	
" " 1901...	...	1017.8	" 632.4 "	
" " 1902...	...	1077.	" 673. "	

Since the beginning of the present year applications for new extensions amounting to over 500 kiloms. or 312 miles have been made.

Applications for new extensions.

These applications are principally for lines in Lower Egypt, in the Province of Menufieh. But all three Companies have been asked to

extend. This is due to the general appreciation of the lines in sections through which they run as is shown by the large increase of passengers and goods, and to connect up more fully their systems.

Increase of
Passengers.

The passengers carried by the three Companies during 1901 were 3,951,419 and during 1902 4,368,884, an increase of nearly half a million, a very good showing considering the epidemic of cholera that was prevalent during the last half of the year. Details of numbers of passengers carried, receipts, etc., are shown in Table No. 1.

Increase of
Goods.

Each of the Companies show an increase in their goods receipts which may be considered very satisfactory as the cotton crop was short as compared to that of the previous year. The traffic in building materials in all the provinces has much increased and largely added to the receipts of the Companies: it is satisfactory to note the demand for these goods, as it shows a prosperous condition of the people and the country. Table No. 2 attached shows the receipts from goods, expenditure, etc.

Plant.

The roadbeds are generally good. The rolling stock throughout is good, but not sufficient for the demand upon it in all districts during the busy season. This shortage is realized, and more engines with greater hauling power and more spacious carriages and trucks with larger diameter of wheels are to be supplied, and these new consignments will be used in the districts where the traffic is heaviest, and the old and smaller stock will be pushed out on to new sections and to places where the traffic will be lighter. The compartment system is practically used throughout, but there are a few carriages of the corridor type: they are not suitable on the narrow gauge railways where economy of space has to be considered.

Speed of
Trains.

Trains run well within the speed allowed by the Concession, viz: - 30 kiloms. per hour, and the service generally is quite fast enough, except perhaps in the case of the Mansourah and Matariéh Co., where there is a metre gauge. A faster service might be advantageous on their main line run from Mansourah to Matariéh.

Time Table.

Great difficulty has been experienced in arranging suitable time tables, the chief trouble being to give passengers a good service, and at the same time to lift goods promptly. Most of the trains up to the present have been mixed, and both passengers and goods are moved

together. This will rectify itself in the near future: with the increase of traffic separate goods trains will have to be more generally run; they are now working in several of the provinces. It is quite evident that a fast service with mixed trains cannot look after the goods traffic, and a very slow time table to enable them to lift goods promptly would not satisfy the travelling public. Further than this, they must connect as near as possible with the Government trains, and it must also be remembered that owing to the busy season in winter a different time table is required.

There are at present only three level crossings with the Government Level Crossings. lines, and of these only two are being used, one at Benha and the other on the Rahmanieh line behind Damanhour. The level crossing at Edwa has been suppressed and a subway made, and at Kotour the Light Railway Company cannot practically work their crossing and it is not used. This reduces the number of level crossings to two instead of four as last year. As to the existing level crossings and those likely to be asked for in the future, it is my opinion they should be allowed under certain proper restrictions, and that each case should be considered on its own merits. Some points to consider would be:—

(a) The position of the crossing relative to the Government Station; if near, the crossing can be under the control of the Station Master.

(b) The difficulty of going under or over the Government line for the Light Railways with regard to expense, practicability, etc.

(c) The extent of traffic on the Government line in question; the Government reserving the right at any time in case of increased traffic to suppress the crossing or ask for a subway or overbridge.

The Matarieh-Mansourah Company and the Fayoum Light Railway Telephones and Telegraphs. Co. have very good systems of telephones throughout. The Egyptian Delta Co. has a partial system of telegraphs over all the most important sections. They added 55 kilometres to their lines during the year and dismantled an unimportant section in the Eastern Province from Belbeis to Minet El Gamhr, a distance of 25 kilometres, making a net increase of 30 kilometres or $18\frac{3}{4}$ miles, with 75 kilometres or $46\frac{7}{8}$ miles now being laid. When this is completed there will still remain 300 kilometres to lay to give the Company an entire telegraphic connection, but in these parts the traffic is light and few trains are run, so that there is no immediate need for it.

Working
jointly with
the Govern-
ment lines.

Through booking is allowed the Companies with the State Railways, and joint stations and transhipping platforms at certain points to facilitate the transport of crops and merchandise and to generally fulfil the purpose of usefulness to the trunk lines to act as feeders to them. These connections do give in theory what is required, but in practice the results are not always satisfactory and a great deal of traffic is lost to the Government and Light Lines owing to the delays experienced in the transport of the goods at the joint stations. Consigners use the railways in order to secure quick delivery even at a greater cost, but if they find that owing to delays their goods can go as fast by water and for less money, the canals and river get the business the railways should have. The delays doubtless occur through non co-operation. If opposition is to be shown, it should be before the joint stations are allowed, and not afterwards. They should be worked as a connected up system with break of gauge and not in opposition one to the other.

Accidents.

No accidents to passengers have been reported, although several of the employes of the Companies have been killed owing to carelessness on their own part, but no claims have been established against the Companies for damages owing to neglect or faulty construction of the lines: from time to time there have been derailments reported, and they have been due to neglect on the part of the pointsmen at sidings, but no more serious results than delay to passengers have happened. The points, as on all railways, being a weakness are especially so on agricultural lines, as the light materials used on the permanent way require constant attention with repairs and renewals. There are few points or switches now on any of the systems that are not manned, and at stations where sidings have been placed and they are not often used, the points are securely locked, and can only be opened by train's staff as required.

Passengers
Rates.

The Egyptian Delta Light Railway Co. has been experimenting with the fares in the Eastern Province by reducing their prices for part of the year, but without good results and have now reverted to the old fares as previously used.

The Mansourah-Matarieh Co. has made no change in its fares.

The Fayoum Company reduced its fares, but found that the change was not profitable, and they now propose to try some experiments. From experience gained on these lines as well as those of the Egyptian Railway, it would seem that a rate of about 1.5 milliemes per kilometre is the most profitable for the third class passengers' traffic, provided

the station to station charge does not exceed five milliemes except for distances over 7 kilometres. As regards first class traffic, about double to third rate appears to be the most advantageous if no second class accommodation is provided.

The Light Railway Commission is now revising the goods tariffs Goods Tariffs of the Companies.

The Delta Co. have during the last year still further reduced their ratio of working expenses to 61.46% as against 72% of the gross receipts for the previous year. Working Expenses and their ratio to Gross Receipts

The Mansourah-Matarieli expenses and their ratio to their gross receipts were 55.52%, about the same as for 1901, which were 55%.

While the Fayoum Company are working their system at 92.5% of their gross receipts.

The working expenses of the Companies are shown in Table III as compared to their gross receipts. None of the Companies seem to be over-staffed, and including the Managing Staff, District Engineers and Traffic officers, and all monthly paid men employed, there are about 3 men for every two kilometres. Coal at 7 shillings per ton less than it was in 1901 does not appear to have reduced the working expenses. Two of the Companies have expended about the same as last year. The Fayoum Company has increased its expenditure from £E. 71.4 to £E. 78 per kilometre per annum. The latter Company's figures were considered very low last year, and no doubt as stated, they will be increased still further during the current year with increase of kilometrage and traffic more will be required for maintenance and working of the lines.

The sabakh and broken pottery from the earth koms is not procured sabakh as easily for the fellaheen or the Light Railway Companies as it should be. Difficulty is experienced by the Railway Companies to get permission to lay lines into some of the koms, and it is almost impossible to get the sabakh at all without lines into the koms, as the roads for carts, etc., are generally very bad. The result is that in the Fayoum the fellaheen just in the vicinity do get some but the Province generally is not supplied, and it is only those who can afford to pay for loading first into carts, hauling several kilometres and then transferring into Light Railway trucks that are able to get it. Very low rates are quoted by the Railway Companies for the transport of this sabakh, and I should say the only solution would be to allow the Light

Railway Companies to lay their lines to any of the koms that the Government do not wish to preserve. This would give a fair distribution of a fertilizer and stop the unfair advantage which is now enjoyed by certain Europeans. The Light Railway Companies might be made responsible for the preservation of any antiquities found on the lines of any old city foundation, and act as a check over the many that do work in the koms in a small way. The broken pottery found at the koms has been put at an almost prohibitory price as was the case last year, and there is no sign of its moving. There is much material in these old sites that is unfit for sabakh, and it appears to me that a good use to put it to would be to take this clay for filling in the many stagnant pools that are so numerous near the stations and villages: this would be a beneficial measure for all concerned, as the pools are a serious menace to the public health. This work could be profitably undertaken by all the Railway Companies.

The Egyptian
Delta Light
Railway Co.

The Delta Light Railway Company with their large system of lines may be considered thoroughly organised though their sections are not connected up in all the provinces, but further connections are now being allowed the Company, which should greatly help them, and with the consignments of rolling stock ordered and with that which has been recently received, it will soon be a well equipped system.

The lines are rapidly developing outlying sections and the increase of traffic both in passengers and goods is most satisfactory. To cope with the traffic in some sections separate goods trains are regularly run. The Company has done a lot of good work in filling in some of the stagnant pools near villages, but there still remains much to be done, for which permission has not yet been obtained from the Government. A new traffic in stone from Abou-Zaabal quarries, Charkieh Province, promises to be a most profitable undertaking. There seem to have been no special factors in the receipts from passengers or goods for 1902 that cannot be counted on for this year, and we may safely look for continued and increased prosperity. The maintenance of their lines is improving and the running good, except were they have followed too closely the canals and winding roads, as in the East Province. The work of surveying is now being pushed on to enable this Company to start some of their new extensions and to further connect up their lines.

The
Mansourah-
Maturieh Light
Railway Co.

The Mansourah-Maturieh Co. with only a short line and branch are a fully equipped and well maintained system throughout. Though

heavily handicapped having their lines paralleled so closely with navigable canals, they are opening up waste lands, which are developing very fast : the traffic in building materials is good, and the passenger traffic is excellent.

The Fayoum Company is also a very well equipped line. Road beds and rolling stock are very good. Their receipts are steadily increasing chiefly due to the very rapid development of the outlying districts, and the large traffic in building materials including the output of a very good lime stone from quarries recently being opened up. Fayoum Light
Railway Co.

The sabakh traffic has been very much hampered by not having a siding into the kom, but this has now been granted the Company and will no doubt very much increase receipts. In this Province still a lot of work is being done by camels and donkeys, much more than in other provinces, and it does unquestionably affect the receipts of the Company. The experiments with tariffs now being tried will no doubt largely overcome this competition. The Company has asked for several short extensions to connect up their system better, and to change their alignment on one branch.

In closing I may state that all these Companies are working satisfactorily although there is some improvement to be made before they can be considered entirely efficient. They are undoubtedly doing a great work by developing waste lands and giving the agriculturalist better markets. A matter of importance is the necessity in future for the Companies to order engines with greater hauling power, otherwise they may prove to be inadequate for the work they will have to do.

The Delta Light Railway Company has already foreseen this, and are ordering in accordance with it.

The Mansourah-Matarieh Company have sufficient hauling power for any increase likely to come, while the same precautions as those taken by the Delta Company must be observed in the Fayoum Province for further orders for their engines.

I have the honour to be, Sir,
Your Obedient Servant,

JAMES A. GUNN.
Inspector and Secretary Light Railway Commission.

AGRICULTURAL RAILWAYS.

Table No. I. DETAILS OF COACHING RECEIPTS. *Annual Report, December, 1902.*

Number	Title of Line.	Average length of line opened to traffic during 1902.	NUMBER OF PASSENGERS CARRIED.					RECEIPTS.		Year to which figures refer.
			First Class.	Second Class.	Third Class.	Total.	Passengers per kilometre of line opened to traffic.	Average sum paid for each ticket.	Total coaching receipts.	
		Kilometres. Miles.						Mill.	£ R.	
1	Egyptian Delta Light Railway Co., ...	$\left. \begin{array}{l} \text{K.} \\ 796 \text{ or} \\ \text{M.} \\ 497\frac{1}{2} \end{array} \right\}$	$\left. \begin{array}{l} 161,014 \\ \{ \end{array} \right\}$	—	3,150,434	3,311,448	4,160	20	67,524	$\left. \begin{array}{l} \text{Aug. 1901 to} \\ \text{Sept. 1902.} \end{array} \right\}$
2	Minseurah-Matruh ...	$\left. \begin{array}{l} \text{K.} \\ 109 \text{ or} \\ \text{M.} \\ 68\frac{1}{2} \end{array} \right\}$	$\left. \begin{array}{l} 2,631 \\ \{ \end{array} \right\}$	58,810	5,56,002	617,443	5,664	23'4	14,477	$\left. \begin{array}{l} \text{July 1901 to} \\ \text{June 1902.} \end{array} \right\}$
3	Fayoum Agricultural Light Railway Co., ...	$\left. \begin{array}{l} \text{K.} \\ 143'6 \text{ or} \\ \text{M.} \\ 89\frac{1}{4} \end{array} \right\}$	$\left. \begin{array}{l} 5,655 \\ \{ \end{array} \right\}$	—	434,338	439,993	3,076	$\left. \begin{array}{l} \text{1st Class} \\ 63'06 \\ \text{3rd Class} \\ 14'62 \end{array} \right\}$	6,705	$\left. \begin{array}{l} \text{Jan. 1901 to} \\ \text{Dec. 1902.} \end{array} \right\}$

AGRICULTURAL RAILWAYS.

Table No. II.

DETAILS OF PERMANENT WAY.

Annual Report, 1902.

Number	TITLE OF LINE.	Provinces.	Term of concession.	Date of concession.	Approximate length of lines mentioned in concession.	Gauge of lines.	Weight of rails.	Length of lines opened December 1901.	Length of lines opened during 1902.	Total length of lines December 1902.	Lines under construction.
			Years.		Kiloms. Miles.	Meters. Ft. Ins.	Kilop.lm. Lbs. p. yd.	Kiloms. Miles.	Kiloms. Miles.	Kiloms. Miles.	Kiloms. Miles.
1	Egyptian Delta Light Railway Co.	Behera Gharbiéh Charkieh Dakahlieh Kahoulieh	70	1896	K. 514 321	M. 0.75 2' 5½"	K. 14.880 or 32 l. & 12 ozs. 18 or 30.10 oz.	K. 779 or 486 miles.	K. 21 or 13½ miles.	K. 800 or 500 miles.	K. 11½ or 7 miles.
2	Mansourah-Muttariéh.	Dakahlieh	50	1895	100 or 62 miles.	1.00 or 3' 3½"	23.140 or 50 l. & 15 ozs.	109 or 68½ miles.	Nil.	109 or 68½ miles.	None.
3	Fayoum Agricultural Light Railway Company	Fayoum	70	1897	146 or 91 M.	0.75 or 2' 5½"	15.88 or 34.1 oz.	129 or 80½	39 or 24½ miles.	168 or 105	None.
	Total number of kilometres ...				760	—	—	1017	60	1077	11½
	Total number of miles				474	—	—	634½	37½	673½	7 miles.

AGRICULTURAL RAILWAYS.

Table No. III.

Goods and Coaching Receipts.

Annual Receipts, 1902.

Number	Title or Line.	Average length of line opened to traffic during 1901.	Goods carried.	Receipts from goods.	Receipts from coaching.	Total gross receipts including every-thing.	Gross receipts per kilom. including every-thing.	Total expendi- ture.	Annual working expenses per kilom. of line.	Annual net receipts per kilom. of line.	Ratio of working expenses to gross receipts.	Ratio of goods receipts to coaching receipts.
			Tons.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	of	to
1	Egyptian Delta Light Railway Company	796 or 497½	463,928	45,384	67,693	125,010	158	77,193	97	61	61.46	1 to 1.56
2	Mansourah-Matruh	109 } or 68	55,008	7,380	14,477	20,080	184	11,150	102	82	55.52	1 to 1.96
3	Fayoum Agricultural Light Railways ...	143.6 } or 89¼	75,550	4,969	6,705	12,130	84	11,225	78	6	92.5	1 to 1.34

REPORT
ON THE
GIZA ZOOLOGICAL GARDENS
For 1902

BY
STANLEY S. FLOWER,
DIRECTOR.

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REPORT ON THE GIZA ZOOLOGICAL GARDENS FOR 1902.

I. STAFF.

1 Director — 1 Assistant Director —
21 Keepers — 40 Gardeners — 18 Watchmen labourers, etc.

The staff consisted in all, of eighty-one men on monthly pay; also a varying number, up to thirty, labourers on daily pay.

II. VISITORS.

The number of visitors as compared with previous years is shown in the following table:—

	1899	1900	1901	1902
January	3,870	3,550	5,757	6,956
February	5,928	4,798	5,744	6,331
March	5,090	4,441	5,737	7,699
April	4,701	8,439	9,922	4,437
May	6,388	2,816	3,525	3,571
June	2,249	3,141	3,203	3,250
July	2,241	2,423	2,284	2,273
August	2,578	3,153	2,706	1,697
September	3,125	3,098	2,652	2,170
October	2,266	2,364	2,572	2,856
November	2,204	2,930	2,881	2,438
December	2,927	3,143	3,728	3,639
TOTAL	43,567	44,296	52,711	47,117

III. ALPHABETICAL LIST OF DONORS, AND THEIR DONATIONS DURING 1902.

H.H. THE KHEDIVÉ.

1 Bandar Monkey, <i>Macacus rheus</i>	} 18th Nov.
3 Circassian goats, <i>Capra hircus</i> var.	

ADAMS, MR. Y., Gezira.

1 Guinea Fowl, <i>Numida ptilorhyncha</i>	4th May.
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AHMED BEY RAGUEB, Judge, Beni Suef.

1 Broh Monkey, <i>Macacus nemestrinus</i>	23rd Sept.
1 Bandar Monkey, <i>Macacus rheus</i>...	...	...	...	...	25th Sept.

AHMED FUAD EFFENDI, Giza.

1 Grivet Monkey, <i>Cercopithecus sabanus</i>	14th Jan.
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AHMED SHAHIN, Giza.

1 Mongoose, <i>Herpestes ichneumon</i>	29th Aug.
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AHMED ZEKI PASHA, H. E., A.D.C., Cairo.

1 Krb Monkey, <i>Macacus cynomolgus</i>	23rd June.
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AMIN BEY BADR, SAGHIKOLAGHASI, Coastguards.

1 Worn Lizard, <i>Varanus griseus</i>	27th Aug.
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ANGLO-SUDANESE GOVERNMENT.

2 Leopards, <i>Felis pardus</i>	16th Jan.
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ANTHONY, MR. H. M., Ministry of Finance.

1 Stone-Curlew, <i>Œdinenas crepitans</i>	25th Aug.
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BAKR AHMED, Embabeh.

1 Mongoose, <i>Herpestes ichneumon</i>	27th May.
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BITTER, DR. H., Sanitary Department.

1 Grivet Monkey, <i>Cercopithecus sabanus</i>	1st April.
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BLEWITT BEY, MIRALAI A. (Lt. Col. 60th Rifles),

Mudir, Gezira Mudiria, Sudan.

1 Waterbuck, *Cobus defassa* 21st June.

BOGHOS NUBAR PASHA, H. E., Cairo.

1 Gazelle, *Gazella dorcas* 15th June.

BONHAM CARTER, MR. E., Legal Secretary, Sudan

Civil Service.

2 Spurred Tortoises, *Testudo calcarata* 10th Aug.

BRANCH, MR. J. A. E., F.R.C.V.S., Cairo.

1 Little Owl, *Athene glauc* 11th July.

BRIGGS, LT. COL., G. E., Commanding 3rd Batt.

7th Fusiliers.

1 Gazelle, *Gazella dorcas* 6th Oct.

BUTLER, MR. A. L., F.Z.S., M.B.O.U., Sudan Game

Preservation Dept.

1 Eagle, *Aquila sp. incert* 28th May.

1 Sudanese Goat, *Capra hircus* var... .. 21st June.

1 Marabou Stork, *Leptoptilus crumeniferus* 2nd Nov.

BUTLER BEY, KAIMAKAN, J. H., E. A., Kordofan.

3 Lions, *Felis leo*... .. 10th Aug.

CÆSAR EL HAG., BIMBASHI, E. A., Assuan.

1 Porcupine, *Hystrix cristata* 24th April.

CARTER, MR. HOWARD, Inspector of Antiquities, Luxor.

1 River-Turtle, *Trionyx triunguis* 16th Aug.

CHELU BEY, A., Director of the National Printing

Department.

1 Ring-tailed Lemur, *Lemur catta* 17th May.

CHRISTIAN, MISS ISOBEL, Cairo.

2 White Rats, *Mus decumanus* var 15th April.

COGORDAN, MONSIEUR G., Minister Plenipotentiary of France.

1 Jerboa, <i>Dipus jaculus</i>	} 27th March.
1 Partridge, <i>Cacabis chukar</i>	

CURTIS, MISS FLORENCE, Bulac.

2 Laughing Doves, <i>Turtur risorius</i>	6th Aug.
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DALE, MR. ALFRED, Mansûra.

1 Kra Monkey, <i>Mucacus cynomolgus</i>	1st April.
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DAVIDSON, MR. H. A., Bank of Egypt, Khartoum.

1 Wan Rani, <i>Ovis aries var</i>	21st June.
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DELLA SALLA, COUNTESS, Cairo.

1 Gazelle, <i>Gazella dorcas</i>	28th March.
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DINKLER, DR. O., Cairo.

1 Egyptian Weasel, <i>Putorius africanus</i>	30th June.
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DIXON, MISS OLIVE T., Port-Said.

1 Gazelle, <i>Gazella arabica</i>	} 17th May.
1 Fennec Fox, <i>Canis cerdo</i>	

DIXON BEY, F. SANIEH, C.M.Z.S., Port-Said

1 Egyptian Vulture, <i>Neophron percnopterus</i>	19th July.
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DRURY, BOMBASHI W. B., E. A., late R. N.

1 Barshone Jackal, <i>Canis sp. incert</i>	15th Dec.
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FELL, BOMBASHI H. L. H., E.A., late R. N.

2 Shorebills, <i>Baraniiceps rex</i>	28th May.
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FLOWER, MRS. S. S., Giza.

1 Poehard, <i>Fuligula ferina</i>	19th Feb.
1 Zorilla, <i>Ictonyx libyca</i>	22nd Feb.

FLOWER, MISS ROSALIE S., Giza.

1 Rabbit, <i>Lepus cuniculus</i>	27th Sept.
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FLOWER, CAPT. S. S., Giza.

1 Snake, <i>Psemmophis sibilans</i>	21st Jan.
1 Egyptian Weasel, <i>Putorius africanus</i>	27th Feb.
1 Crocodile, <i>Crocodilus niloticus</i>	28th May.
7 Hedgehogs, <i>Erinaceus auritus</i>	15th Aug.
	5th Oct.

Addenda.

GALITZENSTEIN, HERR JACQUES, Cairo.

1 Palm Civet-Cat, *Paradoxurus hermaphroditus* ... 31st Dec.

GARSTIN, SIR WILLIAM, E., G.C.M.G., Cairo.

1 River-Turtle, *Trionyx triunguis* ... 6th March.

GIANACLIS, MONSIEUR NESTOR, Cairo.

2 Gazelles, *Gazella arabica* ... 1st Oct.

HAYMES, BOMBASHI H. E., E.A., R.A.M.C.

1 Leopard, *Felis pardus* ... 28th May.

HODGSON, BOMBASHI H., E.A., 10th Lincolnshire Regt.

1 Addax, *Addax nasomaculatus* ... 24th April.

INNES BEY, DR. WALTER, M.B.O.U., Kasr-el-Aini.

2 Fennec Foxes, *Canis cerdo* ... 21st Aug.

JACKSON, BOMBASHI E. S., E.A. (Capt., Welch Regt.).

2 Spur-winged Plovers, *Hoplopterus spinosus* ... 19th July.

JACKSON PASHA, LEWA H. W., C.B., (Colonel, late Gordon Highlanders) Mudir of Dongola.

3 Baboons, <i>Cynocephalus anubis</i> ...	} 28th May.
2 Secretary Birds, <i>Serpentarius reptiliarius</i> ...	
2 Spur-winged Geese, <i>Plectropterus rueppelli</i> ...	

KAMEL-EL-DIN PASHA, H. H. PRINCE, Giza.

1 Eagle, *Aquila sp. incert* ... 4th Feb.

LANGLEY, MR. JOHN, Irrigation Service, P. W. D.

1 Egyptian Hare, *Lepus sp.* ... 6th July.

LIECHTENSTEIN, H. S. H. PRINCE HENRY, Vienna.

2 Oribi, <i>Ourebia montana</i> ...	} 21st June.
1 White Oryx, <i>Oryx leucoryx</i> ...	

LOAT, MR. W. L. S., F.Z.S., M.B.O.U., Cumnor Place,
near Oxford.

1 Leopard Tortoise, *Testudo pardalis* ... 28th May.

LOISO, MR. C. N., Wadi Halfa.

1 Marabou Stork, *Leptoptilos crumeniferus* 24th April.

MACGREGOR, MR. J., 6 Rue Cherif Pasha, Alexandria.

1 Ferret Fox, *Canis cerdo* 29th July.

MARDROUS BEY, N., Cairo.

1 Grivet Monkey, *Cercopithecus subvus* 27th Aug.

MARSH, MAJOR F. C., and Officers of Mounted
Infantry, Abbassiyeh.

1 Von Henglin's Gazelle, *Gazella tilonura* 22nd May.

McKERRELL BEY, MIRALAI A. DE S., E.A., (Lt. Col.
79th Highlanders) Madir of Berber.

1 White Orys, *Oryx leucoryx* 24th April.

MIDDLETON, MR. G. B., Sudan Government Steamers.

1 Roan Antelope, *Hippotragus equinus* 21st June.

MOORE, MR. C. H. BIRKSEY, Zeitoun.

2 Flamingoes, *Phaenicopterus roseus*. 18th Feb.

MORAD EFF, SADIK, YUZHASHI. E.A., Camel Corps,
Kordofan.

3 Lions, *Felis leo*... .. 10th Aug.

O'CONNELL BEY, KAIMAKAM J. R., E.A., (Major,
Shropshire Light Infantry.)

1 Kudu, *Strepsiceros kudu*... .. 21st June.

PHIPPS BEY, KAIMAKAM P. R., E.A., (Major, Dorset-
shire Regt.).

2 Servals, *Felis serval*... .. 28th May.

1 Wau Ram, *Ovis aries var* 21st June.

QUIBELL, MR. EDWARD. Inspector of Antiquities, Giza.

1 Eagle Owl, *Bubo sp.* 8th June.

ROBERTS, COL. SERGT. A., Rifle Brigade, attached E.A.

1 Red Monkey, *Cercopithecus putas*... .. 28th May.

SLATIN PASHA, LEWA SIR RUDOLPH VON, K.C.M.G.,

C.B., E.A.

1 Shoebill, *Balvaniceps* 28th May.

STAMM, HERR CHRISTIAN, Giza.

2 Young trees, <i>Bauhinia</i> sp.	} 4th March.
2 " " <i>Poinciana regia</i>	
Several Sweet Brier Roses, <i>Rosa rubiginosa</i>	

STUART, MR. M. A. VILLIERS, Survey Dept., P. W. D.

2 Hey's Partridges, *Ammodramus heyi* 10th July.

THOMSON, CAPT. W. M., 72nd Seaforth Highlanders.

1 Red Monkey, *Cercopithecus putas*... .. 10th May.

WILKINSON BEY, MIRALAI E. B., E.A., (Major, 10th
Lincolnshire Regt.).

1 Lioness, *Felis leo* 10th Aug.

WILLIAMS, MR. W. R., Irrigation Service, P. W. D.

1 Jackal, *Canis anthus* 23rd July.

WINGATE PASHA, H. E. FERIK SIR F. REGINALD,

K.C.B., K.C.M.G., D.S.O., A.D.C., Sirdar E.A., and
Governor General of the Sudan.

1 Nuer Ox, *Bos indicus* 21st June.

Thanks are also due to the following Foreign Institutions for presenting
copies of their publications:—

Europe.

1. Bâle.—Zoologischer Garten in Basel.
GOTTFRIED HAGMANN, Director.

2. Dublin.—Royal Zoological Society of Ireland.
D. J. CUNNINGHAM, F.R.S., O.M.Z.S., Secretary.

3. Hague.—Koninklyk Zoölogisch Botanisch Genootschap.
D. N. DIETZ, Directeur.

Asia.

4. Singapore.—Raffles Museum.
M. HELLIER, Acting Curator.
5. Taiping.—Perak Museum.
I. WRAY, F.Z.S., Curator.
6. Trivandrum.—Trivandrum Museum and Public Gardens,
Travancore.
H. S. FERGUSON, F.L.S., F.Z.S., Director.

Australasia.

7. Adelaide.—South Australian Zoological and Acclimatisation
Society.
ALFRED C. MINCHIN, Director.
8. Melbourne.—Zoological and Acclimatisation Society of Victoria.
A. A. C. LE SOUEP, C.M.Z.S., Director.
9. Sydney.—New South Wales Zoological Society.
W. H. CATLETT, F.L.S., F.Z.S., etc., Secretary.

America.

10. New York.—New York Zoological Society.
W. T. HORNADAY, C.M.Z.S., Director.
 11. Washington.—Smithsonian Institution.
S. P. LANGLEY, Secretary.
National Zoological Park.
FRANK BAKER, Superintendent.
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IV. BUILDINGS.

The building and repairing which has been done during 1902 includes :

(i) **Tropical House**, commenced in April, 1902, completed and occupied in December, 1902.

This building comprises two double entrances with two swing doors to avoid draughts, one hall 10 metres (32 feet 10 inches) long by 5 metres wide [interior dimensions] for the animals, cages, a furnace room and keeper's room. It is warmed by seven radiators and cost, including fittings, £E.701.

(ii) **Bears' House**.—This building was overhauled and repainted; the exterior cages were strengthened, and the interior ones partially rebuilt and altered to give shelter to the animals from sun and wind. The cost was £E.179. These two items (i) and (ii) were paid for out of the balance of the Public Debt Commission's grant after paying for the Elephant and Lion Houses built in 1900-1901.

(iii) **Small Cages in the Lion House**, constructed by the gardens staff for the Serval, Caracal, and Civet Cats, etc.

(iv) **Small Cages outside the Lion House**.—To have the Carnivora as much as possible in one part of the gardens, the Jungle Cat's Cage was moved here and two cages built for Foxes.

(v) **The Larder**, designed and constructed by the garden staff was built near the Lion House, to avoid unnecessary conveyance of raw meat about the gardens.

This building was very much needed, as so far there had been no suitable place for keeping meat.

(vi) **Selamlık Paddocks**.—Three of these four paddocks were reconstructed to show the animals off to greater advantage by means of lighter fences and planting of shrubs.

(vii) **Porcupines' Cages**.—Two new cages were erected (near the one made in 1901) for Sudan Porcupines. These (like the other new cages for small mammals) have their floors raised 2 feet 9 inches off the ground. This is found to keep the animals in better health and they are at a convenient height for visitors to see them.

(viii) **Poultry Run** in four parts, built out of old material, placed in the south-east corner of the Haremlık Garden.

(ix) **Western Paddocks.**—Four new paddocks were added to the south, to accommodate the deer whose quarters in the Central Paddocks were required for the new Antelopes.

(x) **Central Paddocks.**—The former Deer Paddocks were slightly altered to accommodate the Kudu, Waterbuck, etc.

(xi) **Birds of Prey Cages.**—A part of the garden, "Ceylon Corner," previously closed to the public and which for many years had been used as stables and wood-yard was tidied up, grass lawns and paths made, and the three old kiosks were turned into large cages suitable for the Secretary Birds, Eagles, etc.

(xii) **Monkey House** (See Reports for 1899, 1900 and 1901.)—This house is in a very bad condition, and extremely draughty.

Attempts to make the roof water-tight have proved unavailing. The monkeys frequently break out of the old cages, and much of the carpenter's time is occupied in repairing these breakages.

(xiii) **Garden Seats.**—Many of the old ones were repainted, those in the Lion House repaired, 48 new chairs bought, and three new benches and two large round seats made in the gardens.

(xiv) **Pavements in Haremlik Garden.**—The work of repairing the marble and mosaic-work pavements, commenced in April 1901, was continued, and all the more important paths put in order.

(xv) **Paths, Haremlik Garden.**—The very worn and uneven flagstones, which paved the main roads, have been replaced by sandal paths; the greater comfort in walking is much appreciated by visitors.

Selamlık garden.—Several new paths were made.

(xvi) **Labels.**—The number of labels with names of animals in English and Arabic was largely added to.

(xvii) **Stag.**—The life-size metal stag erected on the north wall of the Haremlik Gardens during the reign of Ismail Pasha was found to be gradually heeling over, and in danger of falling during high winds, it was therefore lowered to the ground and placed in the north-west corner of the Selamlık Garden.

V. ANIMALS.

(i) *Number of Animals alive in Gardens.*

	6th Oct., 1898		6th Oct., 1899		6th Oct., 1900		6th Oct., 1901		6th Oct., 1902	
	Specimens.	Species.	Specimens.	Species.	Specimens.	Species.	Specimens.	Species.	Specimens.	Species.
<i>Mammals.</i>										
Primates	59	15	66	15	80	19	66	19	69	17
Carnivora	25	12	32	13	67	20	46	17	66	22
Insectivora	—	—	8	1	2	1	1	1	10	1
Chiroptera	—	—	2	1	2	1	2	2	12	1
Rodentia	—	—	4	4	16	7	6	4	25	1
Ungulata	46	17	50	14	82	20	71	18	100	25
Edentata	1	1	1	1	1	1	1	1	1	1
Marsupialia	5	5	2	2	9	6	6	4	4	3
TOTAL MAMMALS.	136	50	172	51	253	75	211	66	287	78
<i>Birds.</i>										
Passeres	7	1	56	7	51	7	64	15	79	20
Psittaci	10	6	30	11	53	17	49	20	74	24
Striges	—	—	—	—	—	—	5	1	4	1
Accipitres	16	7	18	8	26	9	47	11	48	16
Steganopodes	1	1	24	2	15	2	17	2	15	2
Herodiones	1	1	5	3	6	3	6	3	21	7
Odontoglossa	—	—	—	—	—	—	1	1	—	—
Anseres	24	8	40	11	60	14	60	15	63	13
Columbae	30	8	30	7	50	7	45	6	60	8
Pterocletes	1	1	6	2	7	3	23	4	21	1
Gallinae	38	11	49	11	87	10	125	11	117	11
Fulicarinae	—	—	—	—	—	—	1	1	1	1
Alectorides	—	—	1	1	4	2	12	2	10	3
Limicola	—	—	—	—	—	—	—	—	3	2
Gavinae	—	—	3	1	3	1	3	1	3	1
Cathartidae	2	1	2	1	2	1	2	1	—	—
Struthionidae	3	2	5	1	7	1	8	2	7	2
TOTAL BIRDS.	133	47	268	66	371	76	463	93	526	112
<i>Reptiles.</i>										
Chelonia	1	1	13	7	24	8	58	10	63	10
Emydosauria	—	—	2	1	2	1	2	1	3	2
Squamata	—	—	16	6	15	8	33	9	44	9
TOTAL REPTILES.	1	1	31	14	41	17	93	20	110	21
Batrachians	—	—	2	1	5	1	—	—	—	—
GRAND TOTAL...	270	98	473	132	670	169	770	179	923	211

(ii) The following birds observed wild in the gardens during 1902, can be added to the list of forty-five species given in the Report for 1901.

1. Blue-throated Warbler, *Cyanacula suecica*.
2. Roller or "Blue Jay," *Coracias garrula*.
3. Turtle-Dove, *Turtur auritus*.
4. Rock-Dove, *Columba livia*.
5. Little Egret, *Ardea garzetta*.
6. Spoonbill, *Platalea leucorodia*.
7. Coot, *Fulica atra*.

A daily list of the wild birds observed in the gardens has been kept up.

Only four snakes were seen in the gardens during the year, all small and harmless; they were:— one *Eryx jaculus*, one *Taraphis obtusus* and two *Zamenis florulentus*.

(iii) Registered additions to the Menagerie:—

	1899	1900	1901	1902
Acquired by presentation	98	103	74	103
" " purchase	515	209	343	126
Bred in the gardens	27	31	25	64
Received on deposit	26	11	27	39
Obtained in exchange... ..	5	17	5	6
Total	671	371	471	338

Of the additions during 1902 the following should be specially mentioned:—

The Addax presented by Bimbashi Hodgson, 24th April.

The White Oryx presented by McKerrell Bey, 24th April.

The Bactrian Camel purchased, 13th May.

The Von Henglin's Gazelle presented by the Officers of Mounted Infantry, 22nd May.

The Antbear deposited 28th May.

The Secretary Birds presented by Jackson Pasha, C.B., 28th May.

The Snow-bills presented by Slatin Pasha, K.C.M.G., C.B., and Bimbashi Fell, 28th May.

The Great Nuer Ox presented by H. E. the Sirdar, 21st June.

The White Oryx and two Oribi presented by Prince Henry Liechtenstein, 21st June.

The Waterbuck presented by Blewitt Bey, 21st June.

The Roan Antelope presented by Mr. Middleton, 21st June.

The Kudu presented by O'Connell Bey, 21st June.

The three Giraffes, deposited 21st June.

NOTE ON THE SHOEBILL, OR WHALE-HEADED STORK, *Baleniceps rex*.

Two individuals were purchased by the Zoological Society of London in April, 1860 (*V. P. Z. S.*, 1860, p. 243) from Mr. John Petherick, then H. B. M. Consul for the Sudan, who had obtained them in the Sudan, having hatched them from eggs "procured from the Raik negroes..... at a considerable distance from Gaba Shumbyl"; these two were the survivors "out of six *Baleniceps* shipped at Khartoum, but perhaps out of a score partially reared" (*V. op. cit.* pp. 195-199). These were the first specimens of this most extraordinary bird ever brought alive out of the Sudan, and, as far as is known, no others have been till the three, now living in the Giza Zoological Gardens, were brought down forty-two years later.

In the autumn of 1901, Col. W. S. Sparkes, C.M.G., brought a live *Baleniceps* from the Bahr-el-Ghazal to Khartoum, where it is still living in the Governor General's Palace garden. This is the only other specimen known to be living in captivity.

The three birds now at Giza presented by Slatin Pasha and Bimbashi Fell were obtained by the donors from the Bahr-el-Djar, in the Bahr-el-Ghazal province of the Sudan, and were kindly looked after by Mr. A. L. Butler, Superintendent, Sudan Game Preservation Department, till handed over to the Giza Zoological Gardens keepers at Khartoum, 15th May, 1902.

During 1902 the staff of the Giza Zoological Gardens were entrusted with bringing ninety five animals from the Sudan to Giza, including specimens for H. H. the Khedive, and certain foreign Zoological Gardens. These animals were:—

10 Lions.	1 Antbear, <i>Orycteropus aethiopicus</i> .
4 Leopards.	18 Smaller Mammals.
7 Cheetahs.	5 Secretary Birds.
4 Giraffes.	3 Shoebills.
11 Antelopes.	17 Storks, Cranes, Geese, etc.
2 Nuer Cattle.	7 Tortoises.
	1 Crocodile.

Out of the ninety animals eighty-eight reached Giza in safety. The only accidents on the journey were the loss of a fine young male Roan Antelope and a Grey Crane, which had both been purchased in Khartoum for the Giza Zoological Gardens and which both died suddenly near Berber on an exceptionally hot day in May.

The animals sent on from Egypt to the London, Dublin, Calcutta and Pretoria Zoological Gardens all reached their destinations safely, except the Antbear, which died at Marseilles, en route to London.

(iv) Animals bred and reared in the Gardens:—

	1899	1900	1901	1902
Black Lemur, <i>Lemur macaco</i>	2	2	—	—
Dusky Lemur, <i>Lemur fuscus</i>	—	2	—	—
Jackal, <i>Canis anthus</i>	—	—	5	1
Spotted Deer, <i>Cervus axis</i>	1	—	—	—
Sambar, <i>Cervus unicolor</i>	—	—	—	1
Dorcas Gazelle, <i>Gazella dorcas</i>	1	7	3	6
Arab Gazelle, <i>Gazella gazelle</i>	2	—	2	3
Angora Goat, <i>Capra hircus</i>	3	3	2	1
Bornean-Egyptian Goat, <i>Capra hircus</i> ...	3	—	2	—
Ox, <i>Capra nubiana</i> (including hybrids)	—	1	1	8
Hedjaz Sheep, <i>Ovis aries steatopygia</i>	1	2	2	5
Arui Wild Sheep, <i>Ovis levia</i>	—	—	—	1
Cockateel, <i>Calopittacus nova-hollandia</i>	—	—	—	10
Muscovy Duck, <i>Cairina moschata</i>	4	—	—	—
Laughing Dove, <i>Turtur risorius</i>	1	9	—	4
Palm Dove, <i>Turtur senegalensis</i>	4	3	4	18
Central African Dove, <i>Turtur ambiguus</i>	—	—	—	4

Also many Guinea Pigs, Rabbits, Domestic Poultry, etc.

(v) Registered departures from the Menagerie:—

	1899	1900	1901	1902
Sent away from the gardens, for various causes.	10	23	27	88
Disappeared (mostly small birds).... ..	27	21	6	33
Killed by wild foxes, cats, rats, etc.	24	21	20	6
Accidental deaths from animals injuring themselves, or each other	16	10	19	16
Deaths from natural causes	234	194	210	196
Total	310	269	282	339

The only important deaths during 1902 were: the lion "Gonna," the oldest inhabitant of the menagerie, on the 6th February, he had been in feeble health for several years and his death came as a relief to the Giza Zoological Garden Direction, and a young female Roan Antelope which accidentally broke its left femur and had therefore to be killed.

The number of deaths in each month was :—

	1889	1900	1901	1902
January... ..	33	15	19	26
February	22	15	18	14
March... ..	11	15	11	18
April	17	12	11	11
May	19	19	12	8
June	14	18	13	12
July	16	14	11	14
August	11	5	18	13
September	14	11	21	12
October	30	17	17	18
November	31	19	23	20
December	15	34	26	30
Total	233	194	210	196

VI. FORAGE.

The following Table shows the nature of food consumed by the animals and its price for each month of 1903.

	January		February		March		April		May		June		July		August		September		October		November		December		TOTAL	
	£L.	SH.	£L.	SH.	£L.	SH.	£L.	SH.	£L.	SH.	£L.	SH.	£L.	SH.	£L.	SH.	£L.	SH.	£L.	SH.	£L.	SH.	£L.	SH.	£L.	SH.
1 Broad	3	010	3	800	3	897	3	720	4	004	1	007	3	500	0	014	1	000	4	318	3	000	4	588	58	404
2 Engine-iron	15	010	12	320	11	210	10	420	8	800	3	142	19	400	10	020	3	100	0	520	10	400	12	190	794	525
3 Maize	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	62	478
4 Green Grass	—	—	2	000	1	010	1	800	1	200	1	100	1	800	1	800	1	100	—	—	—	—	—	—	12	000
5 Dried Clover	10	020	12	120	11	120	10	400	10	400	12	120	15	450	15	450	14	140	20	600	17	600	19	580	144	650
6 Dried Clover	1	020	0	000	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	61	627
7 Wheat	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	68	680
8 Dried Clover	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	67	670
9 Barley	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	67	670
10 Malva	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	67	670
11 Broad-seed	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	67	670
12 Barley	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	67	670
13 Barley	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	67	670
14 Barley	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	67	670
15 Potatoes	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	67	670
16 Potatoes	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	67	670
17 Lection.	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	1	020	67	670
18 Fruit	3	010	2	020	2	040	3	280	2	240	2	160	6	000	6	210	1	000	3	115	3	000	2	000	400	400
19 Sugar	3	010	3	040	3	010	3	080	3	010	3	080	3	080	3	080	3	080	3	080	3	080	3	080	308	308
20 Salt	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
21 Fish	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
22 Hens-iron	19	—	10	—	10	—	10	—	10	—	10	—	10	—	10	—	10	—	10	—	10	—	10	—	10	—
23 Hens	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
24 Hens	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
25 Pottery	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
26 Eggs	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
27 Milk	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
28 Ground Suet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
31	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
33	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
34	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
36	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
37	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
38	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
39	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
41	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
42	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
43	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
44	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
45	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
46	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
47	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
48	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
49	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
50	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
51	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
52	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
53	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
54	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
55	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
56	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
57	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
58	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
59	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
61	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
62	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
63	—	—	—	—	—	—	—	—	—	—	—															

VII. GATE RECEIPTS.

Table of Gate Money by months for last seven years.

MONTH	1896		1897		1898		1899		1900		1901		1902	
	CE.	M.	CE.	M.	CE.	M.	CE.	M.	CE.	M.	CE.	M.	CE.	M.
January	34	220	109	560	92	340	109	640	95	440	128	270	157	140
February	42	490	84	380	130	900	152	290	113	190	147	870	160	820
March	56	450	106	300	109	540	121	890	110	030	112	320	175	650
April	85	180	95	550	122	030	110	320	173	030	139	460	115	350
May	48	510	66	170	96	620	118	250	56	250	69	090	64	780
June	21	710	39	380	51	450	44	230	55	800	56	680	56	920
July	24	590	32	110	52	960	46	700	49	290	43	640	46	530
August	25	90	39	410	44	620	50	210	62	220	55	570	53	750
September	26	630	47	760	58	520	62	40	62	290	53	030	42	080
October	25	630	41	830	58	900	49	240	51	880	54	990	47	970
November	36	250	46	390	49	990	49	98	61	400	66	830	66	250
December	55	210	57	850	69	360	78	50	82	010	101	490	69	880
Total for the year...	481	960	746	640	937	260	991	950	976	130	1114	840	1637	129

VIII. ACCOUNTS.

Table of Receipts and Expenditure, under the various heads, during 1902.

RECEIPTS.		£R.	Mill.	EXPENDITURE.		£R.	Mill.
1. Balance Credit from 1901 ... ..	...	81	632	1. Salaries, (1917-827), less 101-380 repaid for services to other Departments) ...	...	1,816	447
2. Government contribution for 1902 ... ..	...	1,640	—	2. Keepers' clothing ... ..	...	64	119
3. Grant from Giza-Gezira Gardens Budget ... ..	...	1,619	—	3. Feeding, bedding and fuel for animals ...	...	1,302	084
4. Grant from P.W.D. for buildings and alterations ... ..	...	250	—	4. Repairs, upkeep and extension of buildings and cages ... ..	...	574	651
5. Special grant for Sudanese animals ... ..	...	404	—	5. Purchase and transport of animals (753-152 less 283-586 repaid for outside services) ... ..	...	469	566
6. Gate Receipts (30-12-01 to 28-12-02, inclusive) ... ..	...	1,028	630	6. Printing and stationery ... ..	...	25	717
7. Elephant rides ... ..	...	32	410	7. Band ... ..	...	63	—
8. Sale of animals, eggs, etc. ... ..	...	8	630	8. Sundries (Permanent Advance Account), Library Books ... ..	...	130	699
9. Fines ... ..	...	—	679	9. Upkeep of Garden ... ..	...	24	423
10. Miscellaneous ... ..	...	1	552	10. Upkeep of animals ... ..	...	356	120
				11. Passage money of assistant ... ..	...	20	—
				12. Extra police, telephone and various ...	...	28	321
Total Receipts				Total Expenditure ... ..	...	4,875	147
				Balance Credit ... ..	...	191	386
				Grand Total ... ..	...	5,066	533

IX. AQUARIUM.

The Aquarium at Gezira was opened to the public in November, 1902. It is administered by the Tanzim Service, P. W. D., but the care of the tanks, fish and water plants is entrusted to the Zoological Gardens. There are twenty-four large wall tanks, supplied with partially filtered Nile water.

The following kinds of Nile fish are on exhibition, and are all doing well; several of these it is believed have not previously been induced to live and feed under conditions of captivity.

Family Mormyridæ.

- | | | | | | | |
|-------------------------------|-----|-----|-----|-----|-----|-----------|
| 1. <i>Marcusenius isidoni</i> | ... | ... | ... | ... | ... | Anooma. |
| 2. <i>Gnathonemus</i> sp. | ... | ... | ... | ... | ... | " |
| 3. <i>Mormyrus kannume</i> | ... | ... | ... | ... | ... | Abu hoos. |

Family Characinidæ.

- | | | | | | | |
|-------------------------------|-----|-----|-----|-----|-----|---------------|
| 4. <i>Hydrocyon forskalii</i> | ... | ... | ... | ... | ... | Kell-el-Bahr. |
| 5. <i>Hydrocyon brevis</i> | ... | ... | ... | ... | ... | " |
| 6. <i>Alestes kotschy</i> | ... | ... | ... | ... | ... | Wri. |
| 7. <i>Alestes</i> sp. | ... | ... | ... | ... | ... | Sader Amur. |

Family Cyprinidæ.

- | | | | | | | |
|----------------------------|-----|-----|-----|-----|-----|---------|
| 8. <i>Labeo niloticus?</i> | ... | ... | ... | ... | ... | Berhis. |
| 9. <i>Labeo horie?</i> | ... | ... | ... | ... | ... | Libees. |
| 10. <i>Barbus bynni</i> | ... | ... | ... | ... | ... | Bynni. |
| 11. <i>Barbus</i> sp. | ... | ... | ... | ... | ... | " |

Family Siluridæ.

- | | | | | | | |
|--|-----|-----|-----|-----|-----|--------------|
| 12. <i>Clarias lazera</i> | ... | ... | ... | ... | ... | Armoot. |
| 13. <i>Eutropius</i> sp. | ... | ... | ... | ... | ... | " |
| 14. <i>Schilbe mystus?</i> | ... | ... | ... | ... | ... | Schil Bayer. |
| 15. <i>Bagrus bayad</i> ... | ... | ... | ... | ... | ... | Bayad. |
| 16. <i>Clavates</i> sp. | ... | ... | ... | ... | ... | Abu Rielli. |
| 17. <i>Synodontis schall</i> | ... | ... | ... | ... | ... | Schall. |
| 18. <i>Malapterurus electricus</i> ... | ... | ... | ... | ... | ... | Rau-Ard. |

Family Murænidæ.

- | | | | | | | |
|-------------------------------|-----|-----|-----|-----|-----|--------------|
| 19. <i>Anquilla vulgaris?</i> | ... | ... | ... | ... | ... | Taban samuk. |
|-------------------------------|-----|-----|-----|-----|-----|--------------|

Family Serranidæ.

- | | | | | | | |
|----------------------------|-----|-----|-----|-----|-----|-------|
| 20. <i>Lates niloticus</i> | ... | ... | ... | ... | ... | Ishr. |
|----------------------------|-----|-----|-----|-----|-----|-------|

Family Cichlidae.

21. *Tilapia nilotica* Bolri.

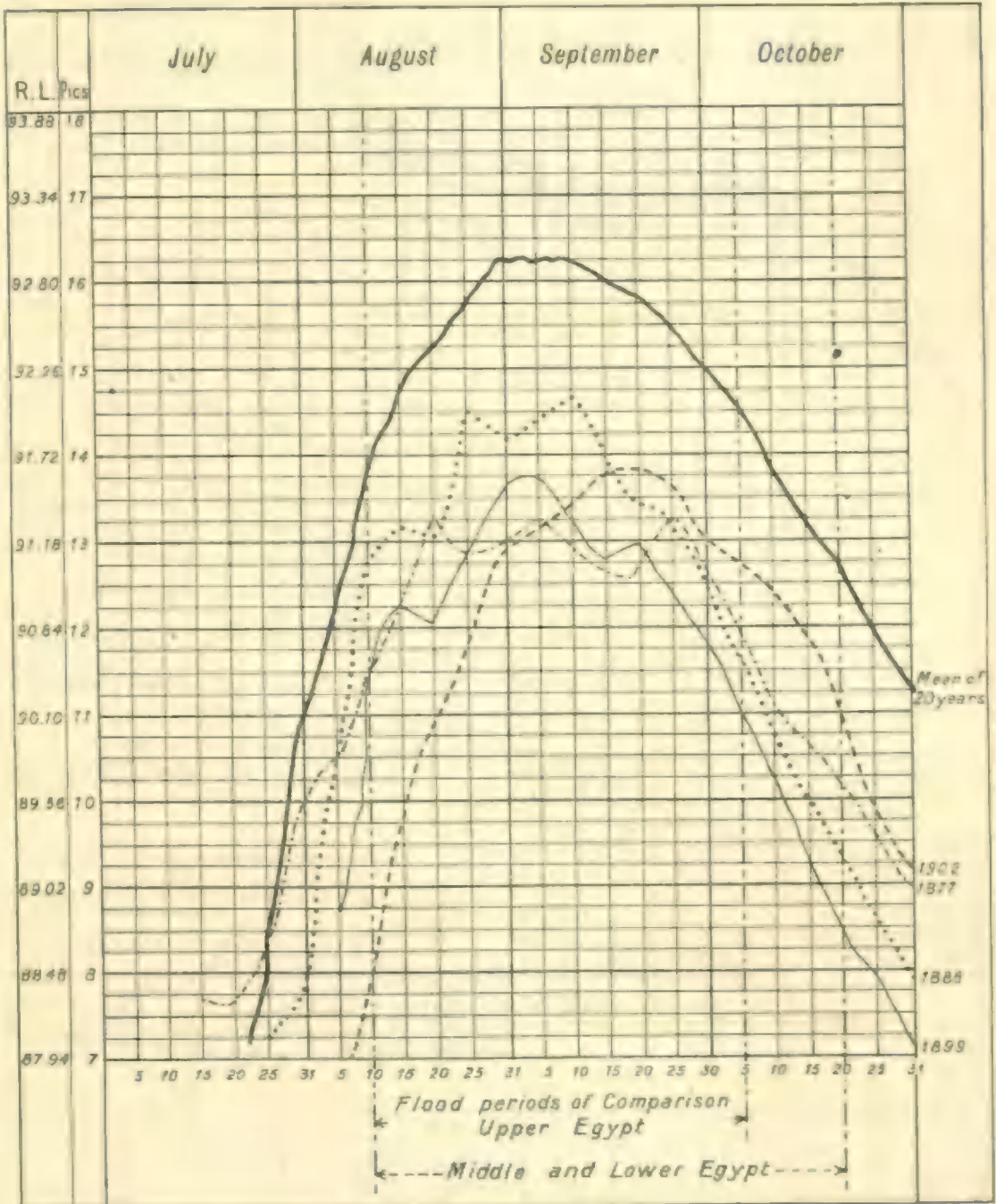
Family Tetrodontidae.

22. *Tetrodon fahaka* Fahaka.

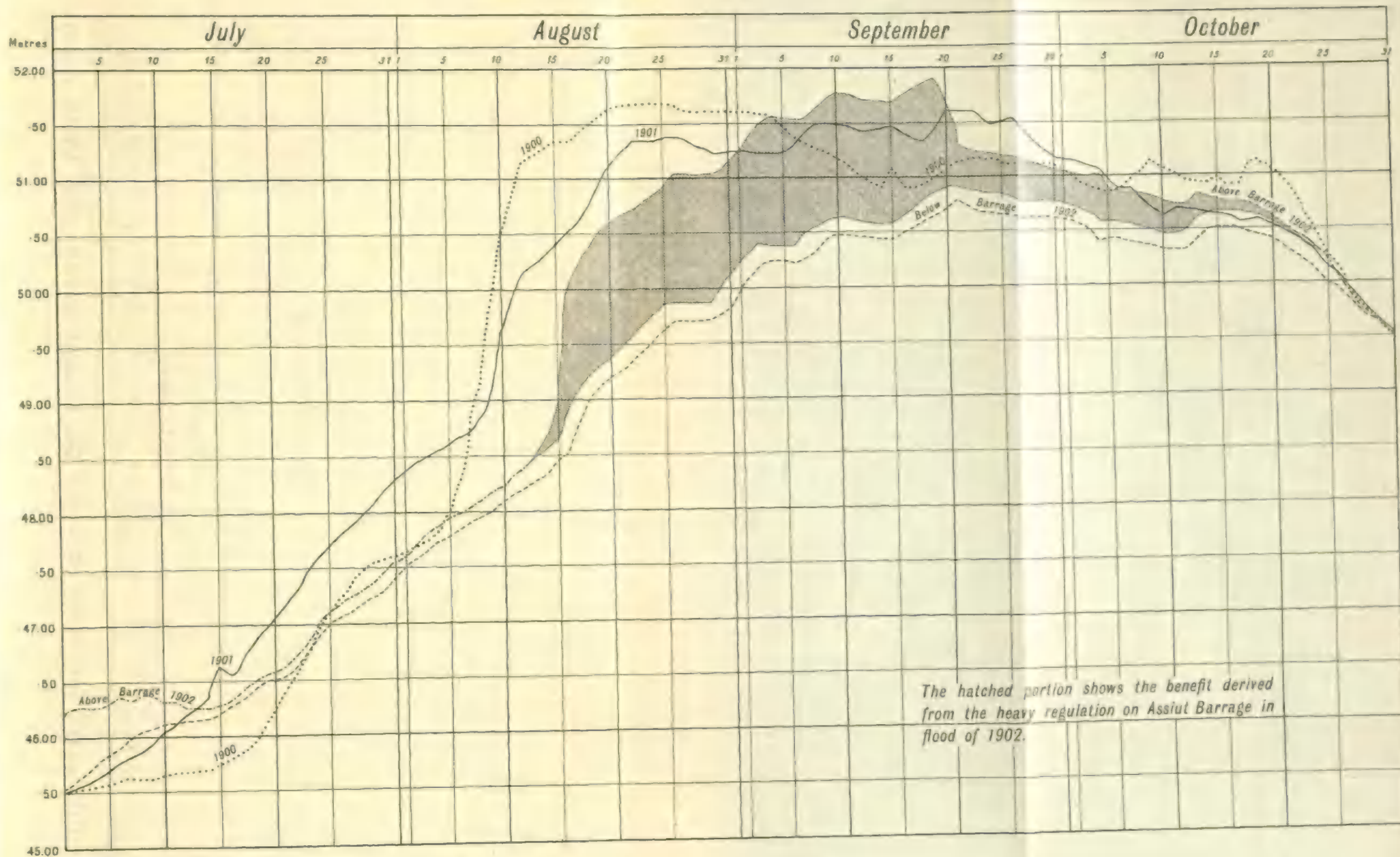
Mr. G. A. Boulenger, F.R.S., British Museum, and Mr. W. L. S. Lout, Inspector of Nile Fish, kindly gave assistance in determining the scientific names of the above fish.

Besides the Nile Fish specimens of varieties of Gold-fish *Carassius auratus* are also exhibited.

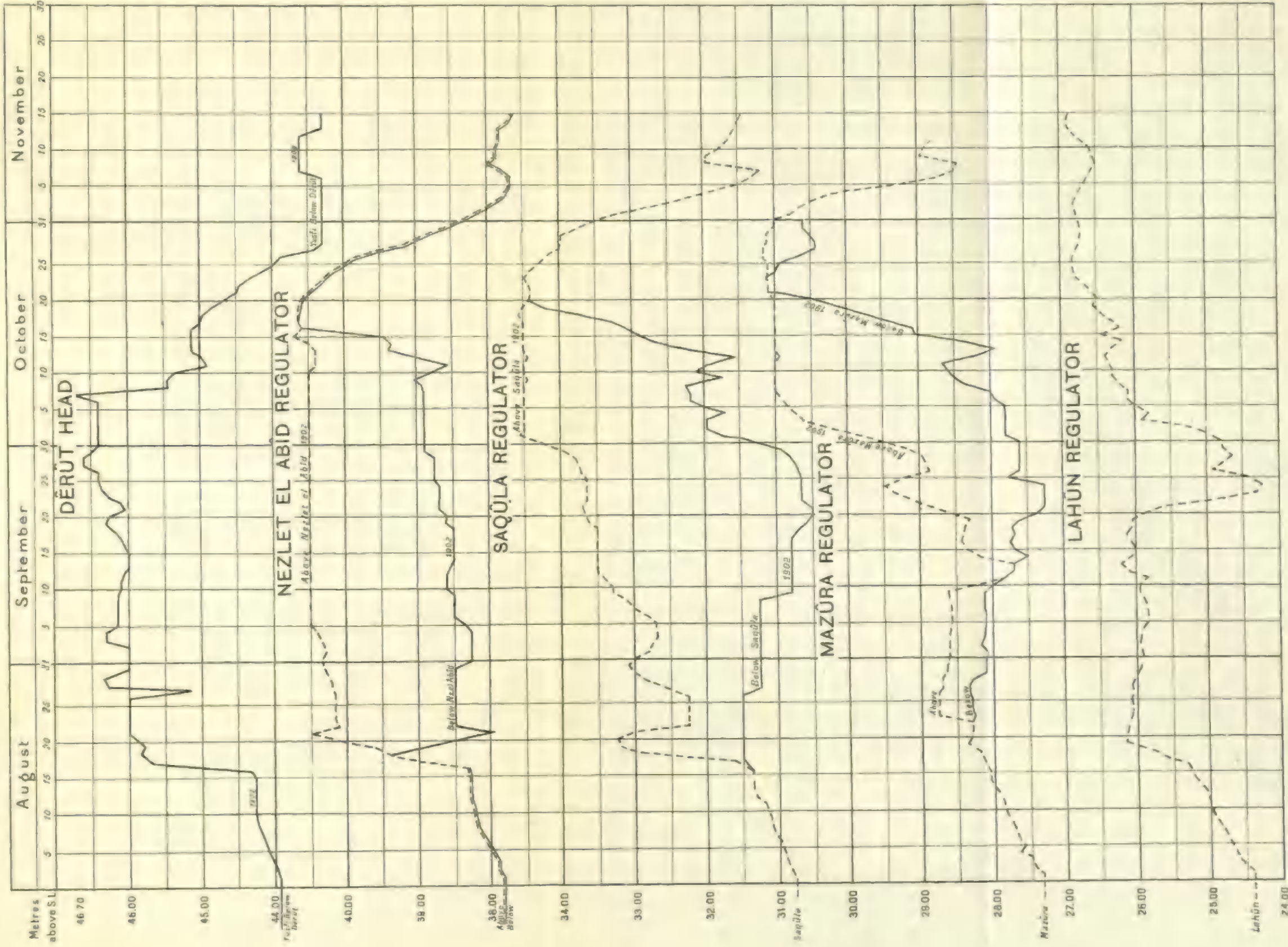
GAUGE AT ASWAN



ASSIUT GAUGES



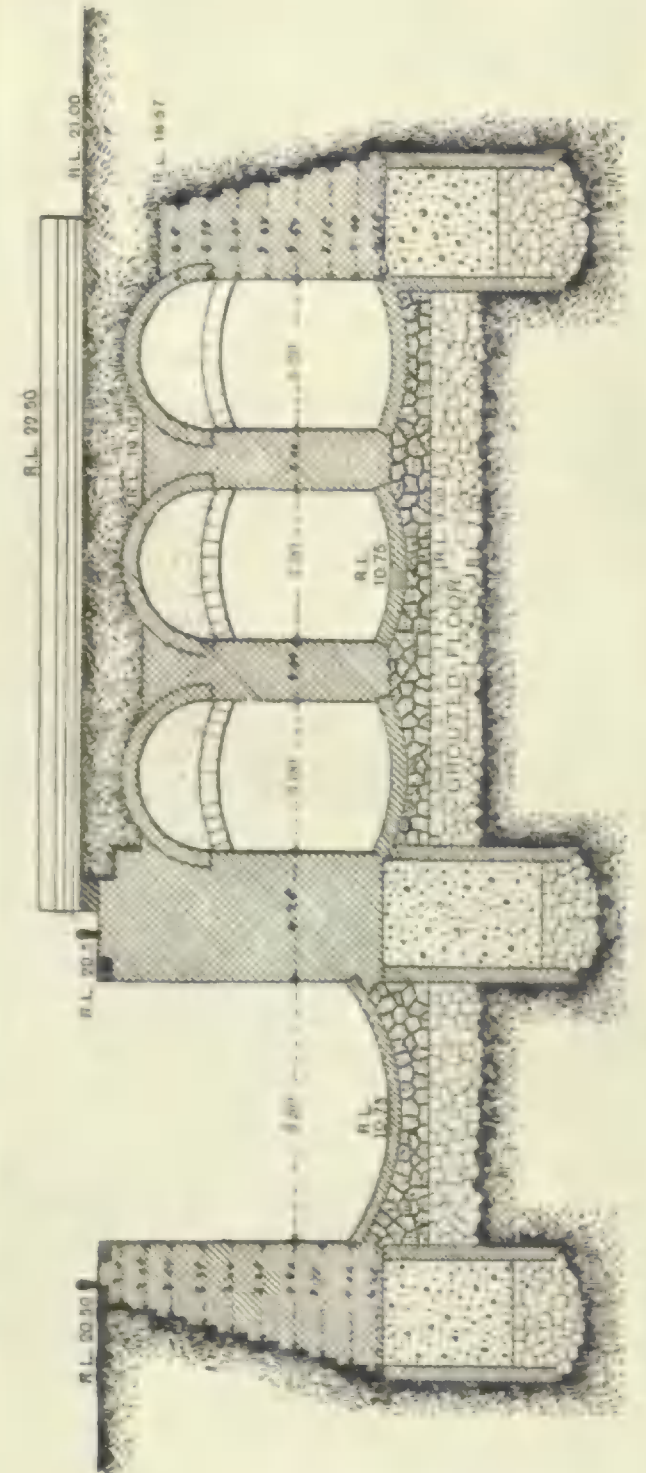
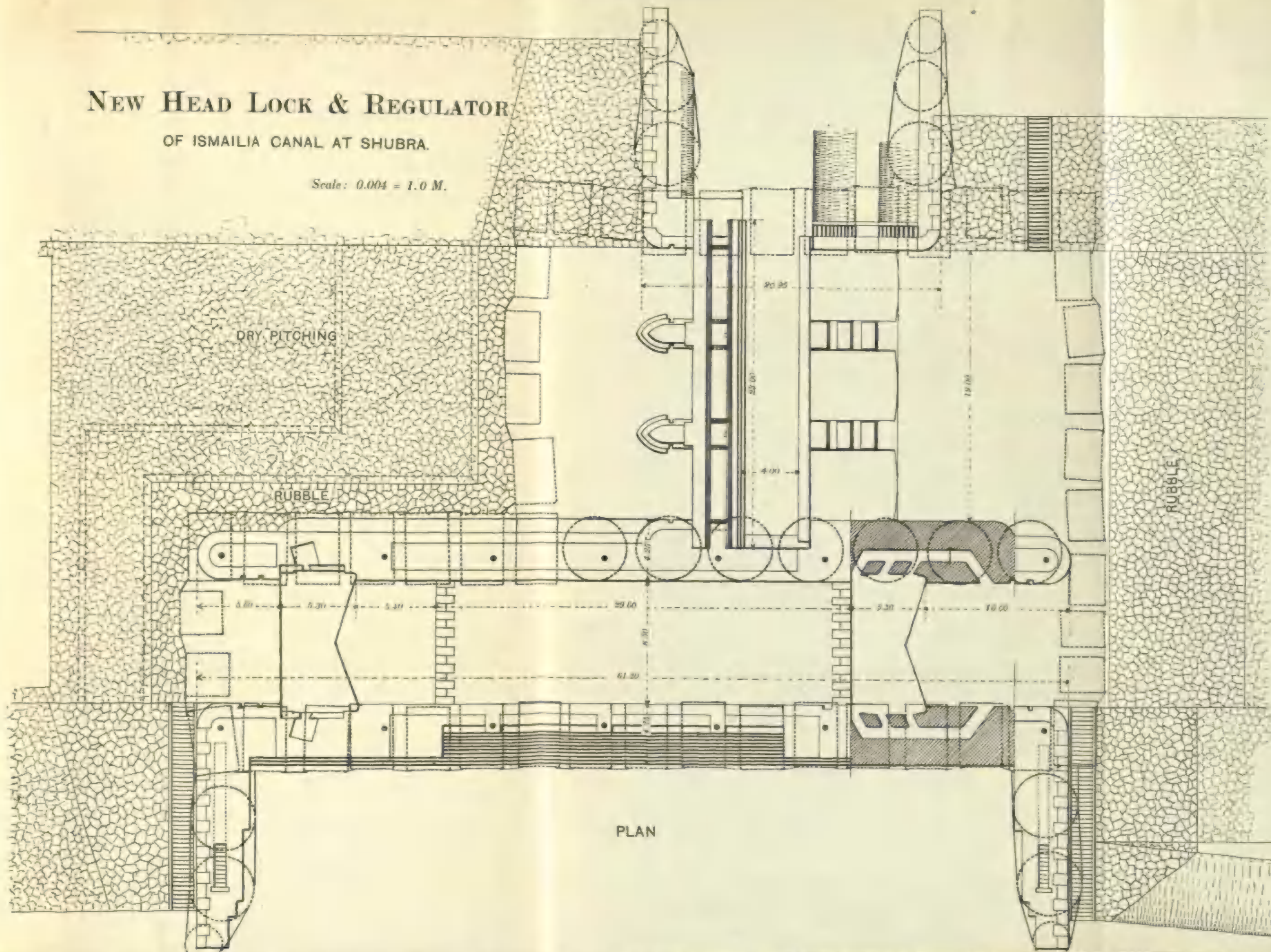
DIAGRAMS SHEWING PASSAGE OF FLOOD DOWN THE BAHR YÜSUF



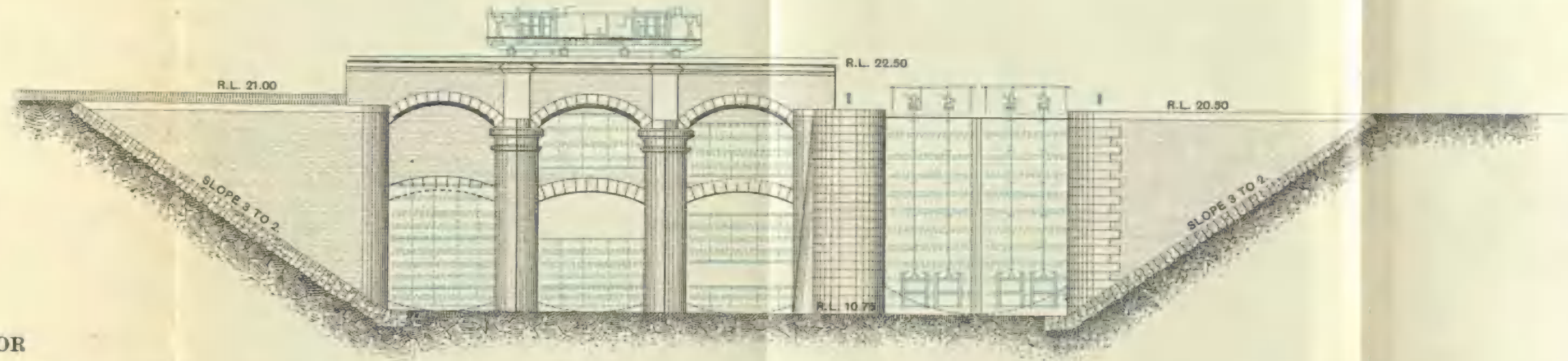
NEW HEAD LOCK & REGULATOR

OF ISMAILIA CANAL AT SHUBRA.

Scale: 0.004 = 1.0 M.



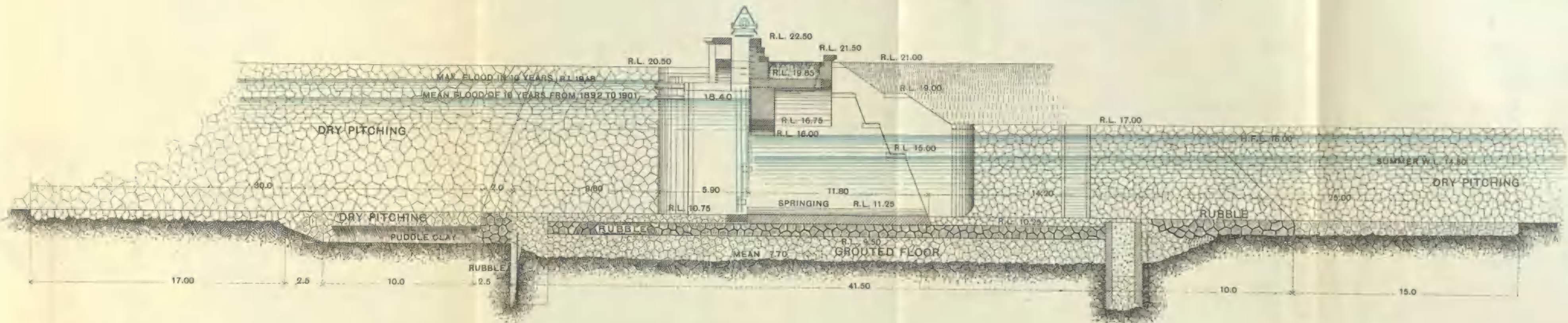
UPSTREAM ELEVATION.



NEW HEAD LOCK & REGULATOR
OF ISMAILIA CANAL AT SHUBRA.

Scale: 0.005 = 1 M.

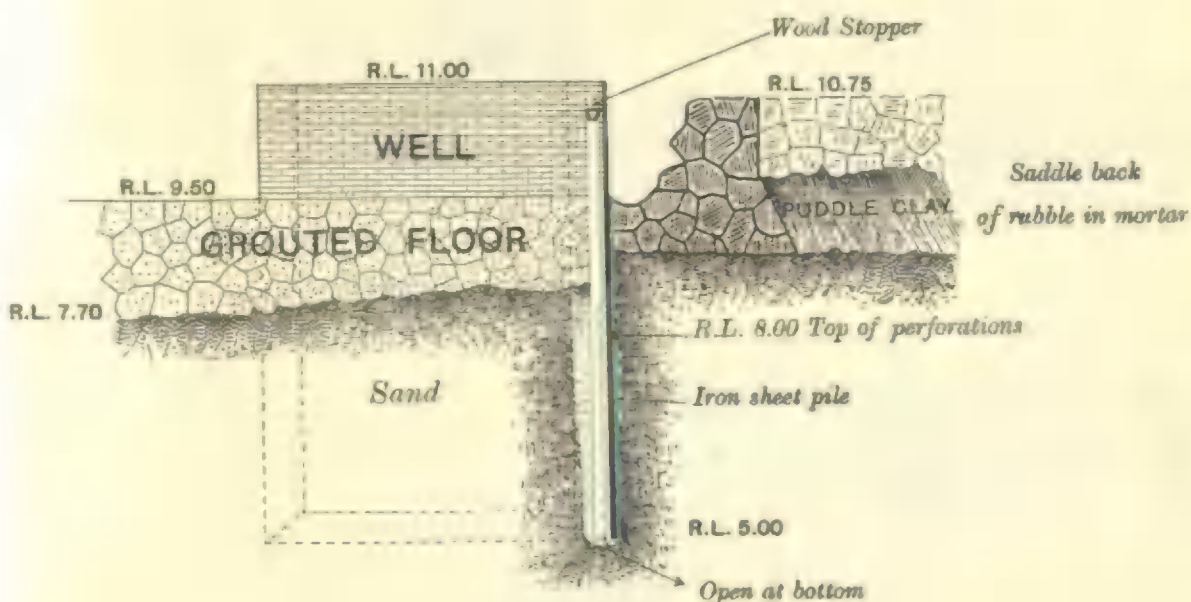
SECTION THROUGH REGULATOR ARCHES.



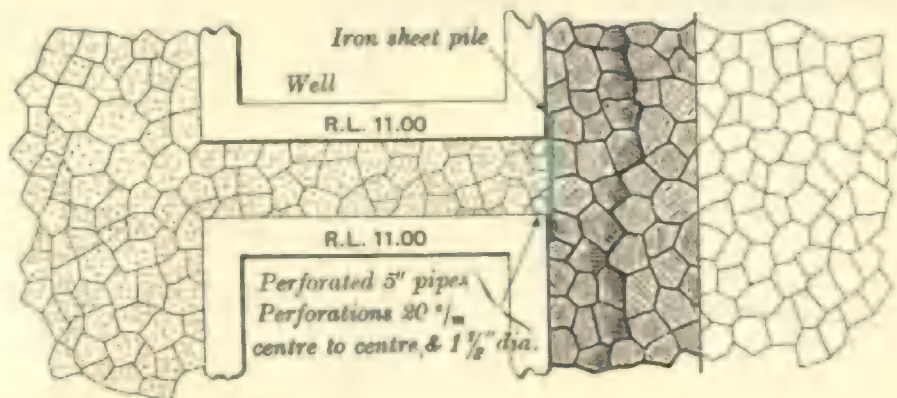
NEW HEAD LOCK & REGULATOR OF ISMAILIA CANAL AT SHUBRA.

Scale: $\frac{1}{100}$

SECTION BETWEEN WELLS SHOWING GROUTING ARRANGEMENT FOR WATER TIGHT CURTAIN



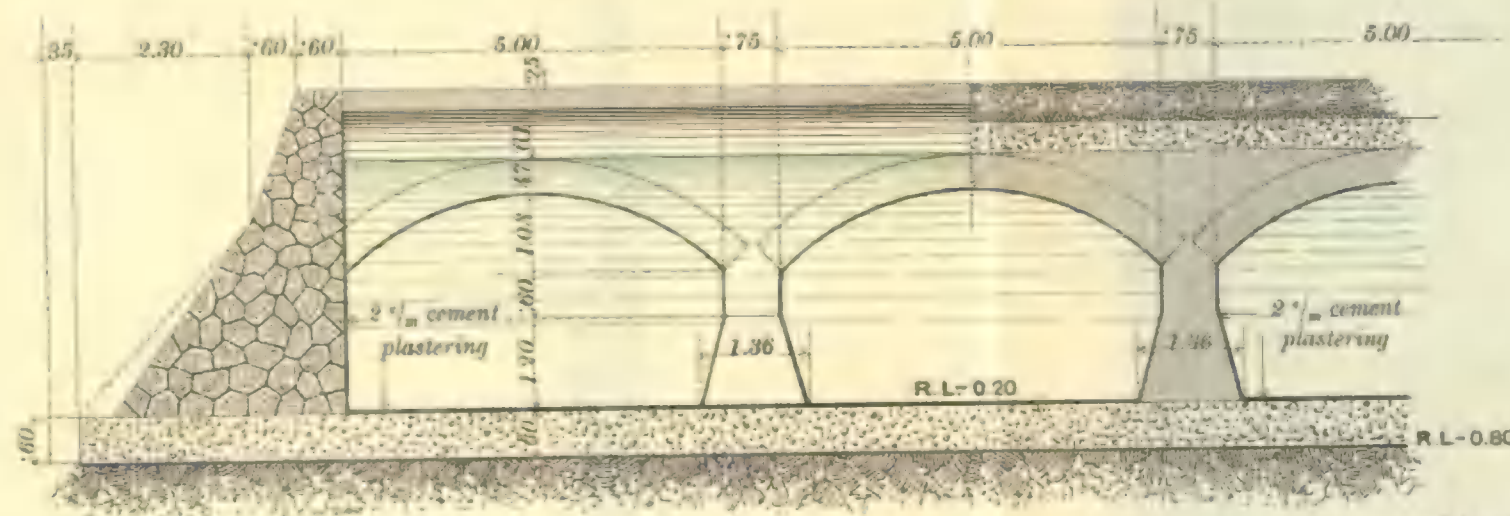
PLAN



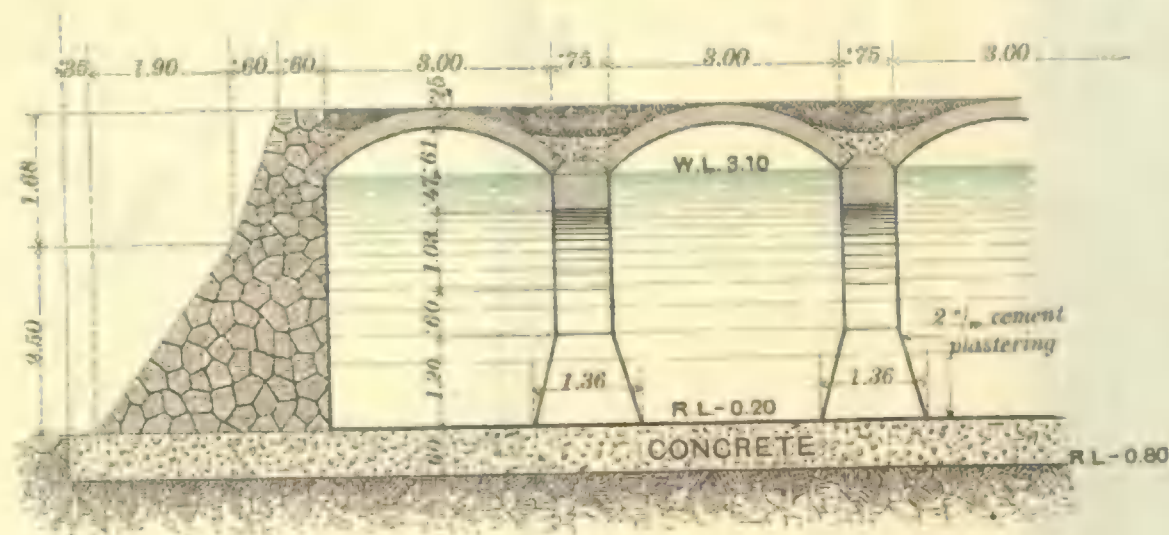
PLAN VII.

EZBET EL BORG RESERVOIR.

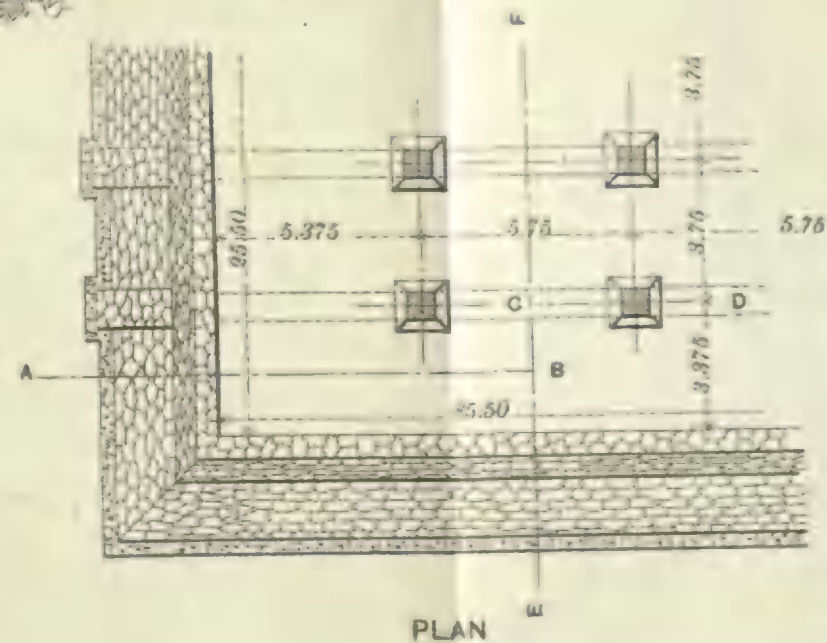
Scale: $\frac{1}{100}$



SECTION A.B.C.D.



SECTION E.F.

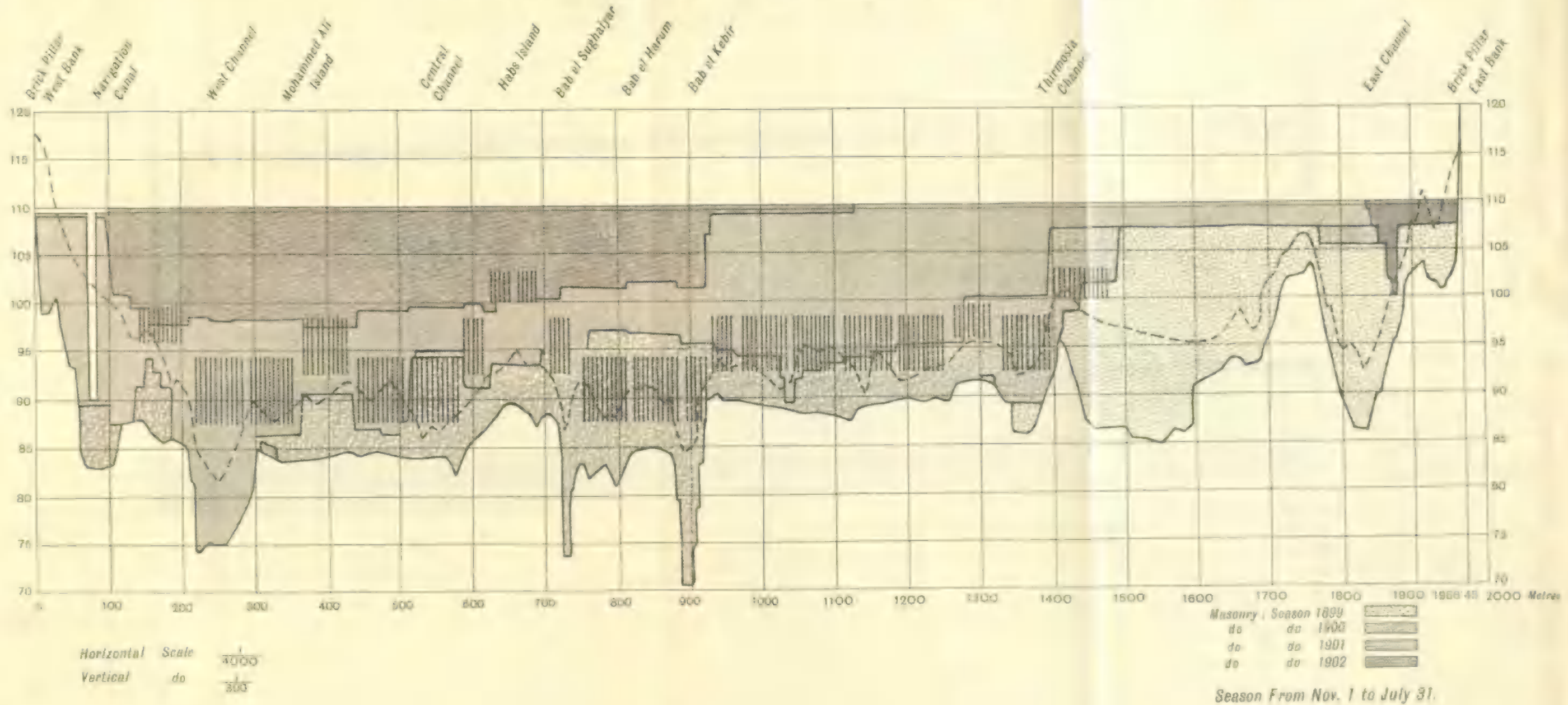




ASWAN DAM

PLAN IX

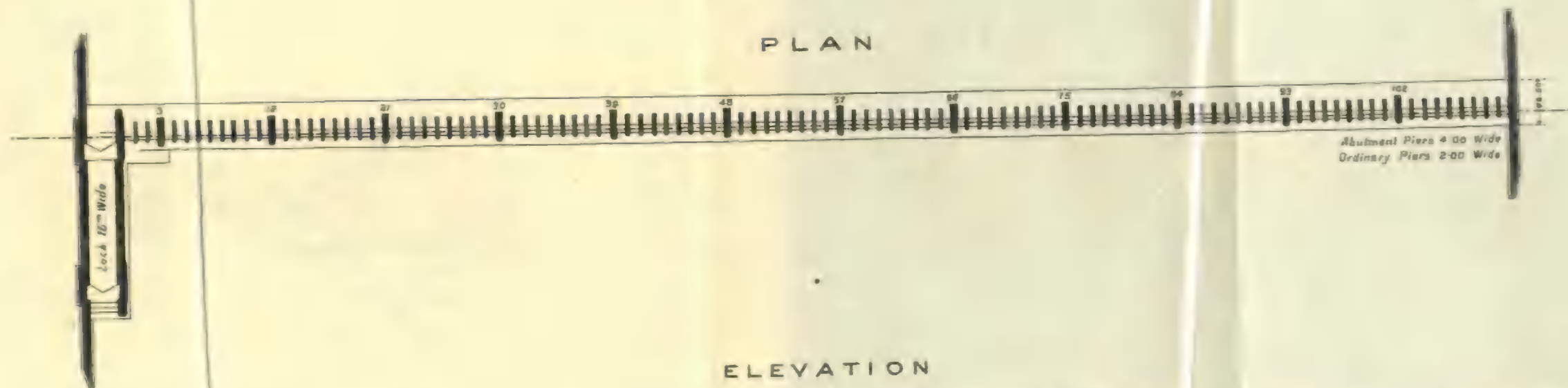
Longitudinal Section on Line of Dam shewing Yearly Progress of Masonry



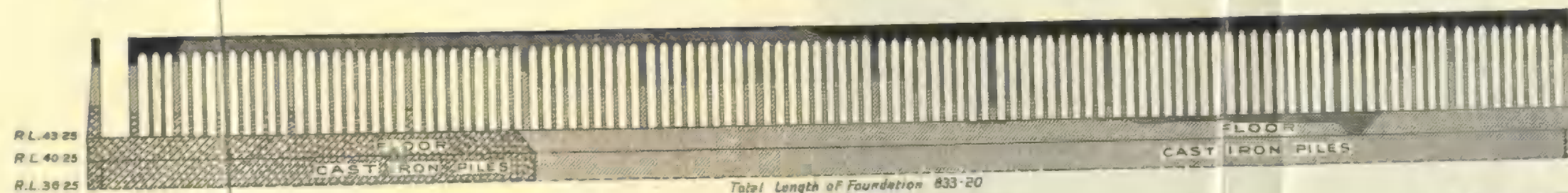
PLAN X.

ASSIUT BARRAGE

PLAN



ELEVATION



R.L. 43.25
R.L. 40.25
R.L. 36.25

Total Length of Foundation 833.20

Scales

Horizontal $\frac{1}{3000}$
Vertical $\frac{1}{750}$

Survey Dep't P.W.M.

Season 1899

1900

1901

1902

(Season: Nov. 1 to July 31)

14. 2

"A book that is shut is but a block"

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